School Shop

vol. II no. 8

April, 1943

Noise in the School Shop
by Mark L. Gluckman

Detailing an Engine Piston
by August Flam

An Auto Shop for Less Than $100
by G. H. Billingham

Demonstrating Alternating Currents
by Ralph O. Williams

Shop-Tested Projects • News from Industry • What Do You Think? • from Washington • Instructional Resources • News

★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★

SPECIFICATIONS

- Swing Over Bed, 10"
- Bed Length, 43⅛"
- Spindle Hole, 25/32" Capacity, ⅝"
- Pre-Loaded Precision Ball Bearing Spindle Mounting
- 12 Spindle Speeds, 30 to 1450 R.P.M.
- Cross Slide Stroke, 3¼"
- Six-Position, Automatic Indexing Turret
- Stroke of Turret, 4¼"
- Precision Ground Ways: 2 Prismatic V-Ways and 2 Flat Ways

★ ★ ★ ★ ★ ★ ★ ★ ★ ★ ★

Logan Speed Collet Chuck for the No. 850 Lathe or others with a 1½" x 8-thread spindle nose. Capacity: ⅝" round bar stock. Quick acting. Positive squeeze grip actuated by plastic hand wheel. No keys or wrenches.

No. 850 Logan Manufacturing Turret Lathe

AN ACCURATE TURRET LATHE for SMALL PARTS PRODUCTION

Developed to meet war industry's urgent need for a fine tool capable of continuous production with sustained accuracy, the No. 850 Logan Turret Lathe has surpassed all expectations. Within the limits of its capacity (⅝" round bar stock) it will turn out parts with the same precision, and with equal or greater speed as that of heavier equipment, which can be released for larger work. And, of course, the investment and operating costs are proportionate to its size. *Complete description and specifications on request.*

LOGAN ENGINEERING COMPANY • Chicago, Illinois

Logan

A NAME TO REMEMBER WHEN YOU THINK OF LATHES

Highlights of Coming Issues

1. "Aeromodeling in Aviation Education."

2. "Pre-flight Bibliography of Instructional Resources."

3. Directory Issue in June of State and Federal Officials, Manufacturers and Suppliers of Equipment.

4. Shop-Tested Projects.

5. And our interesting regular features.

Don't Miss Them!

EDITORIAL ADVISORY BOARD

M. Reed Bass, Director, Ranken School of Mechanical Trades, St. Louis, Missouri
Earl Bedell, Director of Vocational Education, Public Schools, Detroit, Michigan
Elmer W. Christy, Director of Industrial Arts, Public Schools, Cincinnati, Ohio
George B. Cox, Professor of Industrial Education, Oregon State College, Corvallis
Roy G. Fales, Supervisor of Industrial Arts, State Department of Education, Albany, New York
George Fern, Director, State Board for Control of Vocational Education, Lansing, Michigan
R. A. Hinderman, Director Department of Research and Vocational Education, Public Schools, Denver, Colorado
V. P. McKinley, Professor of Trade and Industrial Education, University of Alabama, University
George E. Myers, Professor Emeritus of Vocational Education, University of Michigan, Ann Arbor
Louis V. Newkirk, Director of Industrial Arts, Public Schools, Chicago, Illinois
Irvin S. Noall, Supervisor of Industrial Arts and Occupational Education, Public Schools, Salt Lake City, Utah
Floyd W. Reeves, Professor of Administration, Chicago University
John J. Seidel, State Director of Vocational Education, Baltimore, Md.
Leslie G. Stier, Principal, Frank Wiggins Trade School, Los Angeles, California
F. Theodore Struck, Head, Department of Industrial Education, Pennsylvania State College, State College, Pennsylvania

Editor
Lawrence W. Prakken
Consulting Editors
Marshal L. Byrn and Thomas Diamond
Business Manager
John M. Trytten

School Shop

FOR INDUSTRIAL ARTS & VOCATIONAL EDUCATION TEACHERS

CONTENTS

April, 1943
Vol. II, No. 8

Noise in the School Shop. Mark L. Gluckman 3
The cause, effect, and treatment of noise in the shop.

Detailing a High-Pressure Steam Engine Piston. August Flam 4
A professional draftsman's problem to test the student.

An Auto-Mechanics Shop for Less Than $100. G. H. Billingham 6
A low-cost auto shop for PIT and Red Cross training.

Hand Knurling Tool. Wallace I. Victoria 7
A machine-shop project useful around the metal shop.

Checkerboard Cake Mold. Charles M. Rice 7
A "tin-can" project.

PIT Woodworking Project. John P. Wantuck and Andrew A. Moore 8
A comprehensive woodworking project for "Fundamentals of Shopwork."

Demonstrating Alternating Currents. Ralph O. Williams 10
A teaching device for pre-induction radio and electricity.

News from Industry 16
New products, new equipment, industrial advancements.

What Do You Think: What course that you took in your college training seems most valuable to you now in retrospect as a teacher? 18
Shop teachers examine their college courses.

In the Morning Mail 18
Comments and questions from readers.

News 19
What's doing in the field of industrial education.

Instructional Resources: Books, Pamphlets, Visual Aids 20
Listings in easy form for clipping, pasting, and filing.

Training Teachers Through Employment. Earl L. Bedell 22
Wayne University's program combines study with work in war industry.

Forged Coat Hook. Harold L. Forsea 23
A simple, useful forging project for the general shop.

Strictly Personal 23
About your fellow teachers.

From Washington. William Paca 24
News from the Nation's Capital of interest to shop teachers.

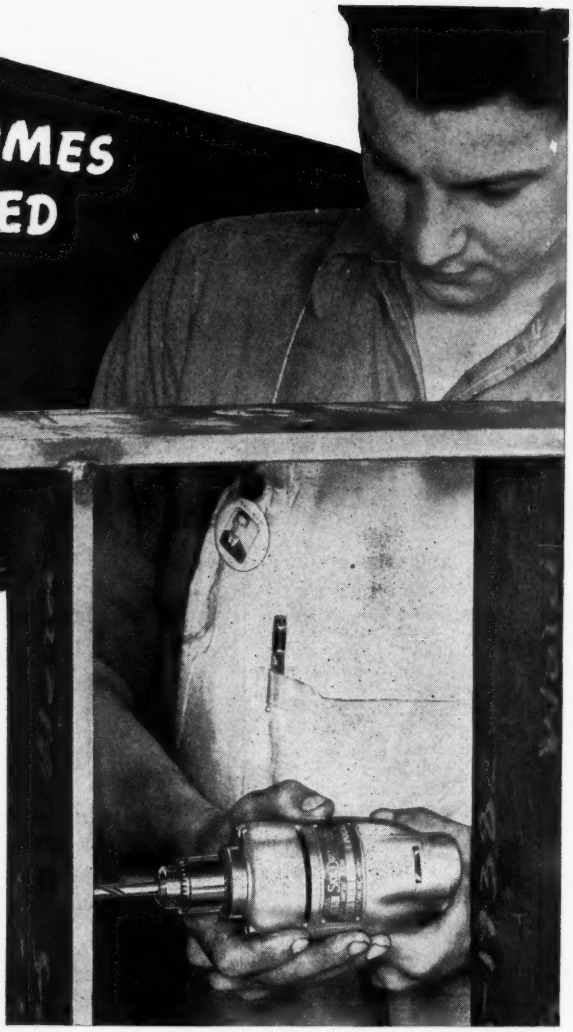
Index to Advertisers 24

School Shop is published monthly, September through June, at Ann Arbor, Michigan. Manuscripts are paid for at regular space rates and should be addressed to the Editor, School Shop, Box 100, Ann Arbor, Michigan. Subscription rates to libraries and institutions, $2.00 a year; Foreign and Canadian, $3.00 a year. 25 cents a copy. Printed in the U. S. A.

Copyright, 1943, by Lawrence W. Prakken.

Advertising Representatives: Eastern—Macintyre & Simpson, Room 1837, 101 Park Ave., New York City, Lexington 2-3783; Mid-West—Macintyre & Simpson, 75 East Wacker Drive, Chicago, Central 1715, and 1900 Euclid Avenue, Cleveland, Ohio, Cherry 1501.

INDUSTRY WELCOMES STUDENTS TRAINED WITH SKILSAW TOOLS!



• America's busiest war plants prefer SKILSAW TOOLS . . . so they prefer new workers trained with SKILSAW TOOLS. They know students reach peak production *sooner* when taught with the tools and methods of industry itself.

SKILSAW TOOLS are lighter, more compact, more powerful. That's why they're such favorites in aircraft, tank and war plants everywhere. Ask your dealer for a convincing demonstration of SKILSAW TOOLS *today!*

SKILSAW DRILLS (Above) speed up every drilling job in every material. Light, compact, powerful for easy handling, fast production. 23 MODELS

SKILSAW BELT SANDERS (Below) do all sanding and "final-finishing" easier, better, 10 times faster. Light, perfectly balanced. 4 MODELS

SKILSAW DISC SANDERS (Left) for all grinding, filing, sanding and polishing of wood, metals, compositions. 6 MODELS

SEND FOR THIS FREE CATALOG!
It illustrates every tool in the SKILSAW *line. Then ask your dealer to demonstrate these tools on the jobs you teach.*

SKILSAW INC., 5029A Elston, Ave., Chicago, Ill.
New York • Boston • Buffalo • Philadelphia • Cleveland • Detroit
Indianapolis • St. Louis • Kansas City • Atlanta • New Orleans
Dallas • Los Angeles • Oakland • Portland • Seattle • Toronto

SKILSAW PORTABLE ELECTRIC TOOLS
★ MAKE AMERICA'S HANDS MORE PRODUCTIVE ★

NOISE in the School Shop

By Mark L. Gluckman

Author Gluckman does not advocate the impossible—silence in the school shop. But he does point out the little things that add up to a crescendo of ear-splitting, neurosis-breeding noise. With the cause apparent, the cure is simple, although it may involve a little soul-searching on the teacher's part. The author teaches machine shop at Samuel Gompers Vocational High School, Bronx, New York City.

NOISE may be defined as one or more discordant sounds loud enough to disturb the nerve centers of the inner ear. A sound that sets the hearing mechanism into such a state of confused vibration that the auditory nerve becomes frayed, is not one to be taken with a shrug and lifted eyebrow. Actual physical as well as mental illness has been traced to excess noise. Small wonder that the shop teacher often leaves his room with a headache and frazzled nerves. Insidiously, the hodge-podge of sounds penetrates the entire body and mind. A nervous state is akin to physical fatigue and both teacher and pupil find an unexplained tiredness that lessens efficiency of instruction as well as ability of concentration. The energy that was destined for useful work finds itself expended in an unconscious effort to resist the inroads of devastating noise.

Some time ago the writer ran a series of tests in an endeavor to find the relationship of results in examinations taken under both noisy and quiet conditions. After 24 tests were given, 12 under noisy and 12 under quiet conditions, it was found that the general average was 10.7 percent better when the tests were taken in a quiet room. All tests were taken in the same shop. Noise was generated by running machinery and leaving doors and windows open. Two classes were employed, the same tests being given to each class. Each week, however, conditions were reversed so no confusion would arise due to the possibility that one class may have been better prepared or more advanced than the other. Results obtained are by no means considered final or arbitrary. They merely point to a possibility of objective proof that noise is a great deterrent to concentration and attention and therefore an enemy of effective teaching.

In analyzing the causes of noise in the school shop, it might be advisable to divide them into five categories: i.e., the pupil, the teacher, the equipment, the room, and extraneous noises.

The Pupil

1. He has a tendency to talk louder than necessary. His ego demands attention and he often can get it no other way than through outshouting his competitor.

2. He engages in verbal arguments, using decibels where logic and reasoning have no effect.

3. He is happy and carefree, forgets himself, and may follow the Disney dictum to "whistle while you work."

4. He has no scruples against interrupting the speech of another boy, causing both to talk at the same time, neither hearing the other.

5. He is too lazy to walk over to another boy and ask a question or borrow a tool; he yells across the room.

6. He is apt to become impatient waiting for a tool at the storeroom and allow his demands to take on a vociferous tone.

7. He may even forget his early training to raise his hand in order to get the attention of his teacher and raise his voice instead. Multiply this factor by three or four and we have a product worthy of consideration.

So much for his vocal attainments. Physically he may do one or more of the following:

1. He drops tools on bench and floor, creating noise as well as inviting boos and laughter from his fellows.

2. He absent-mindedly taps a tattoo on any handy piece of furniture with whatever he may be holding at the time, ruler, screwdriver, or pencil.

3. He neglects to lift his feet when walking and noisily scrapes the floor with his shoes.

4. He hammers on the frail parts of the workbench, rather than seeking an anvil, block of wood, or iron plate.

5. He often uses a dull drill, causing the agonizing high-pitched whistle with which we are so familiar.

6. He slams doors or allows tap water to flow full force.

7. He is not concerned with noisy vibration caused by file, saw, or machine when working on a thin piece of material.

The teacher might well pause for a bit of self-examination and ask himself whether he does not contribute to the general bedlam by:

1. A naturally loud tone.
2. Raising his voice in anger.
3. Yelling across the room.
4. Too much use of the whistle.
5. Absent-minded humming and drumming.
6. Slacking of vigilance through attention to visitor, desk work, repairs, etc.

The Shop

1. Dry, loose, and ill-fitted gears are a source of harsh, painful noise.

2. Vibrating guards and belts that thump against them at each revolution add to the din.

3. Slapping, slipping belts produce squeaks; rosin is only a palliative.

4. Sparking, arcing, and growling commutators and armatures on the motors contribute their share.

5. Shafts running in loose bearings or with extensive end play pound a monotonous tune.

6. Badly balanced grinding wheels send a shiver all through the room.

7. Slipping clutches on overhead drives create noise whenever they are engaged.

8. Weak and improperly fastened benches amplify vibrations and distribute them throughout the room.

9. Machinery not securely fastened to the floor will dance around, creating noise.

10. Improperly cemented, laced, or hooked belts will thump each time the joint rides around the pulleys.

The above may be controlled by the teacher. Other factors producing noise are not as easily cured. These are:

1. Loose flooring, squeaking and groaning at each step.
2. Noisy radiators and steam pipes.
3. Low ceilings that confine noise.
4. Hard, smooth-faced walls which, sanitary though they are, reflect sound, causing it to reverberate.

Finally, we have outside noises adding to the general chaos. Children yelling in the street, mothers calling them off the roadway, hucksters, trucks, horns, etc., etc. These noises we must leave to noise-abatement committees organized in many towns. We can, however, close our windows when the weather allows, leaving open just enough for ventilation. Noises generating in the school halls may either be shut out by keeping the door closed or taking proper disciplinary measures as a school program.

Treatment

In each case, the cause of a distracting noise points to its cure or attenua-

(Continued on page 6)

Detailing a High-Pressure Steam Engine Piston

BY *August Flam*

Here is a professional draftsman's problem that will test the student's ability, observance, and carefulness. August Flam is head of the industrial arts department of John Marshall High School, Los Angeles.

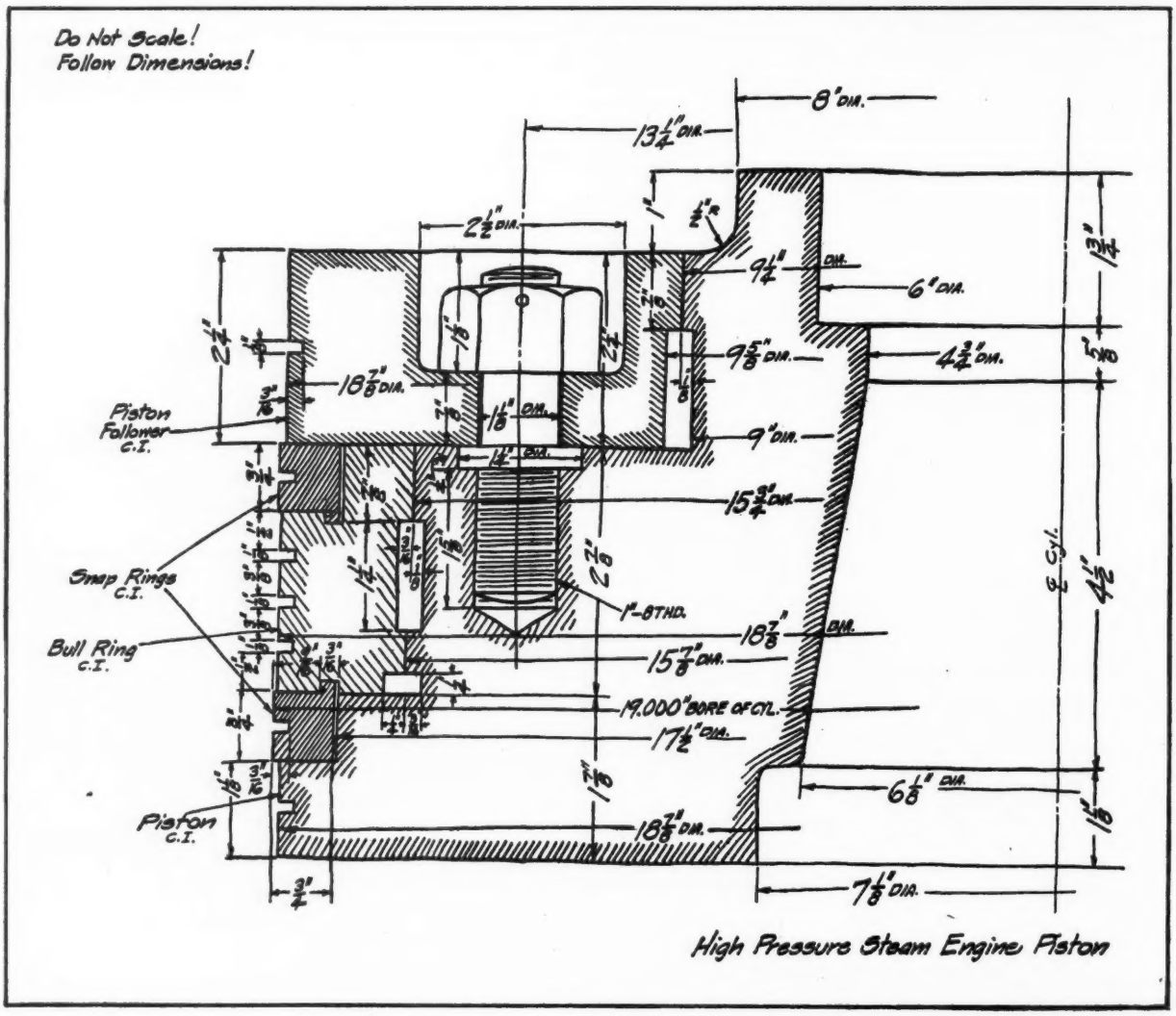
THE freehand sketch shows an assembly section through the center of a high-pressure steam engine piston. A piston of this type has been used in triple expansion marine engines of 2800 I. H. P. used on cargo vessels of 8800 tons.

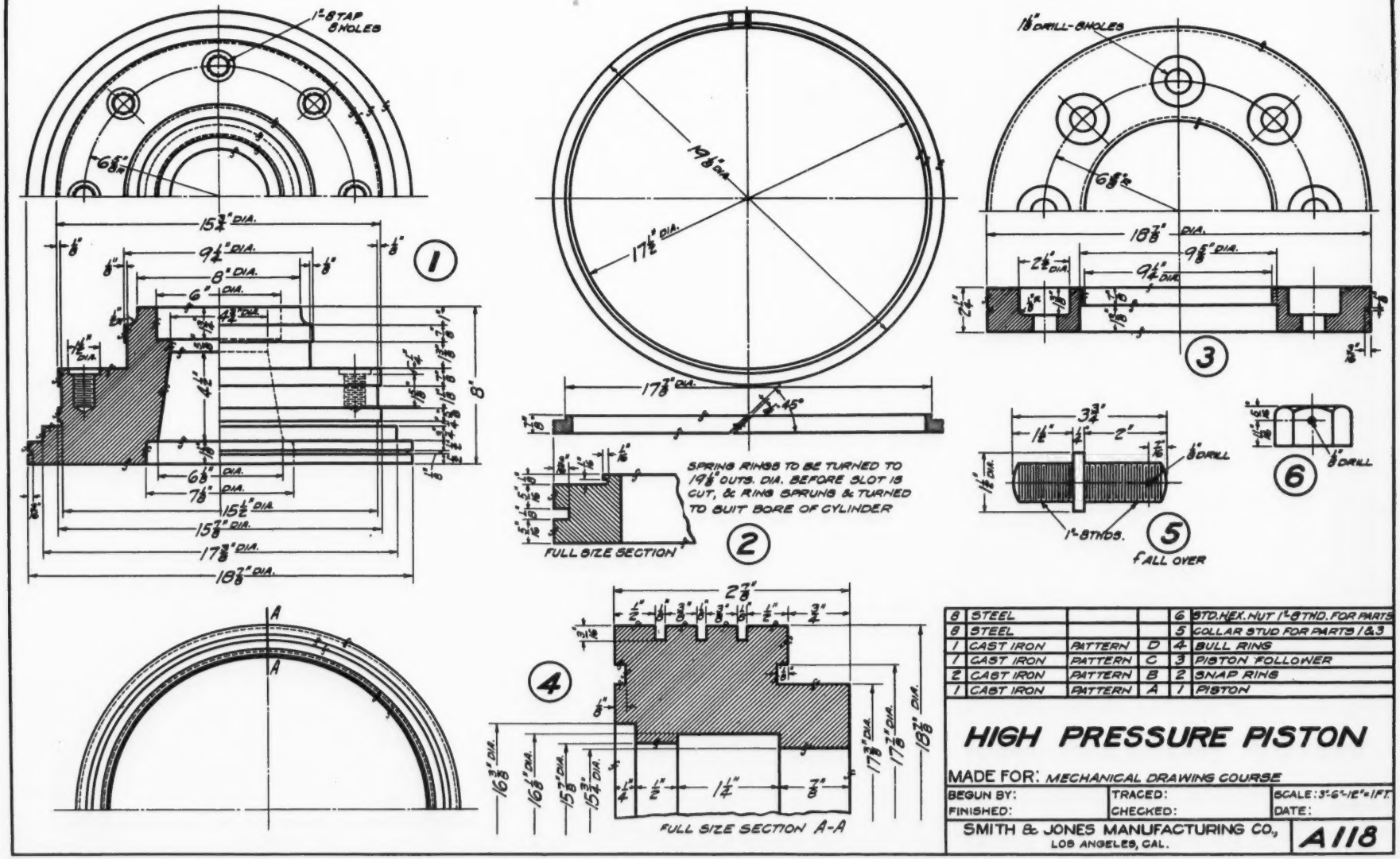
The problem is to detail the four main castings and smaller parts, and also to dimension each piece adequately and to compile a suitable bill of material.

There is sufficient information on the sectional sketch to enable the observant and careful student to detail each part, as in the drawing on the next page. The student should not be permitted to see these completed details, however, until his own details are completed, and then only for comparison and possible correction if errors in his own work are discovered and verified.

The best procedure seems to be to require the student to make his own freehand sketches of each part—using several views—and completing the entire casting, referring only to the freehand assembly sketch. When all the details have been completed, and the drawing has been checked by the instructor, the next problem is to make an assembly drawing—half or full section—from the details made by the student. This serves as a partial check on his accuracy and completeness.

The problem may be reversed by using the completed details given to make a full size assembly leaving off dimensions. Then using this assembly as a layout to scale from, the complete detail drawing may be required.





8	STEEL			6	STD. HEX. NUT 1"-8 THD. FOR PARTS
8	STEEL			5	COLLAR STUD FOR PARTS 1 & 3
1	CAST IRON	PATTERN	D	4	BULL RING
1	CAST IRON	PATTERN	C	3	PISTON FOLLOWER
2	CAST IRON	PATTERN	B	2	SNAP RING
1	CAST IRON	PATTERN	A	1	PISTON

HIGH PRESSURE PISTON

MADE FOR: MECHANICAL DRAWING COURSE

BEGUN BY:	TRACED:	SCALE: 3"-6"-12"=1 FT.
FINISHED:	CHECKED:	DATE:

SMITH & JONES MANUFACTURING CO., LOS ANGELES, CAL.

A118

An Auto-Mechanics Shop FOR LESS THAN $100

BY *G. H. Billingham*

With the emphasis on auto mechanics now because of the pre-induction course which the Army wants schools to organize, readers without shop facilities in this field will be interested in how one school solved the problem in an inexpensive manner. G. H. Billingham is Supervisor of Industrial Arts, Weehawken, N. J.

WE partly met the problem of offering added Victory Corps courses on a limited budget by installing an auto-mechanics shop, at a cost of less than $100. Space for the shop was found on a part of the street-level floor that had previously been used for storage purposes. It was not far from the industrial arts department, had a concrete floor, and was wired for electricity.

A floor plan showed that four motors could be spaced nicely for a group of students to work on. Three motors were obtained from local junk yards at the delivered price of $25. After viewing the shop set-up, a dealer also donated two transmissions and six carburetors, some with fuel pumps attached.

These motors included a Dodge 1933, a Ford V-8 1934, and a Chevrolet 1933. They were left mounted in the frames, which were cut off behind the cross-member back of the motor. The frames were then supported at car-height (17″) on horses made of bleacher material.

We purchased a 1929 Ford for $10 and removed its motor, which was mounted on supports made to our specifications by the blacksmith shop of a local shipyard. A bakery firm donated part of a Ford V-8 truck motor. These motors give us a well-balanced set-up with little investment.

The motors were cleaned up with kerosene and the chassis parts and readily accessible motor parts painted. The rest will be painted as the motors are torn down. As a sink for washing small parts we mounted a large, round metal light shade on a stand—it can conveniently be moved where needed in the shop.

The "works" of a steering wheel were mounted on a base made from channel iron supported at car-height. This, too, is portable and makes an excellent teaching device.

Necessary tools cost us $28, and included the following:

- open-end wrench set
- 2 sets box wrenches
- 2 socket-wrench sets
- 1 ignition set
- 2 hack-saw frames
- 2 handy files
- 2 ignition files
- 1 pinch bar
- 5 assorted heavy-duty screw drivers
- 1 pair safety goggles
- 1 monkey wrench
- 2 machinist's hammers
- 2 putty knives
- 1 set cold chisels
- 2 metal rules
- 1 feeler gage
- 4 spark-plug wrenches
- 1 set smaller screw drivers
- 3 pair pliers — long nose, standard car, heavy duty

Custom tool holders have been made by students to display the tools.

The tool cage was built from discarded bleacher material and a bench from an obsolete science table. The tool rack contains a rack of jars for cotter pins, etc., and a magazine rack for pamphlets of interest to students. A portable rack to hold parts was made from four posts and as many doors from old lockers.

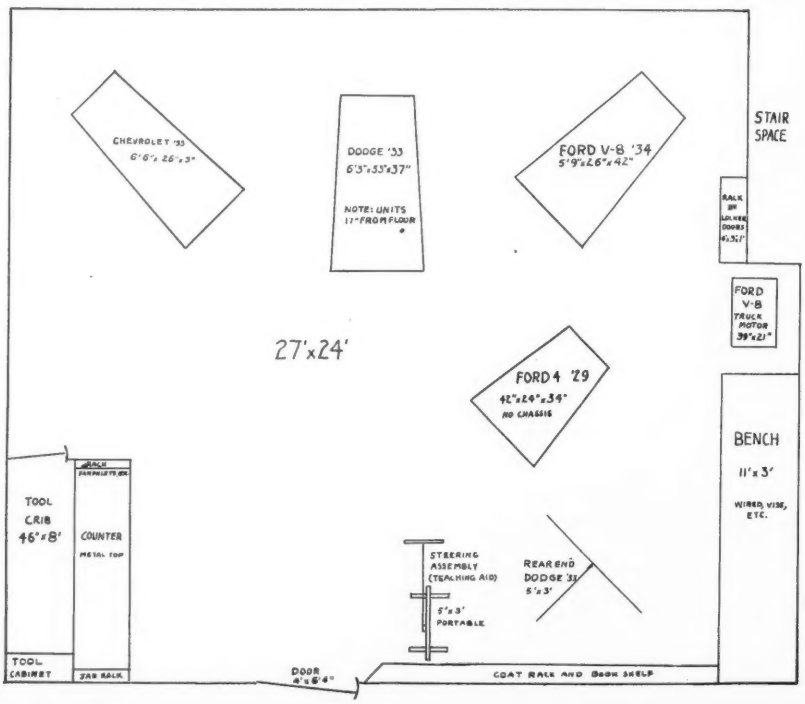
Each student is responsible for whatever aprons or overalls he needs to protect his clothing.

Several local garagemen have promised to provide small parts such as spark plugs, distributors, and extra carburetors.

Auto makers have responded generously to requests for instructional charts. One of the texts will be a shop manual obtained from the manufacturer for 25 cents per copy.

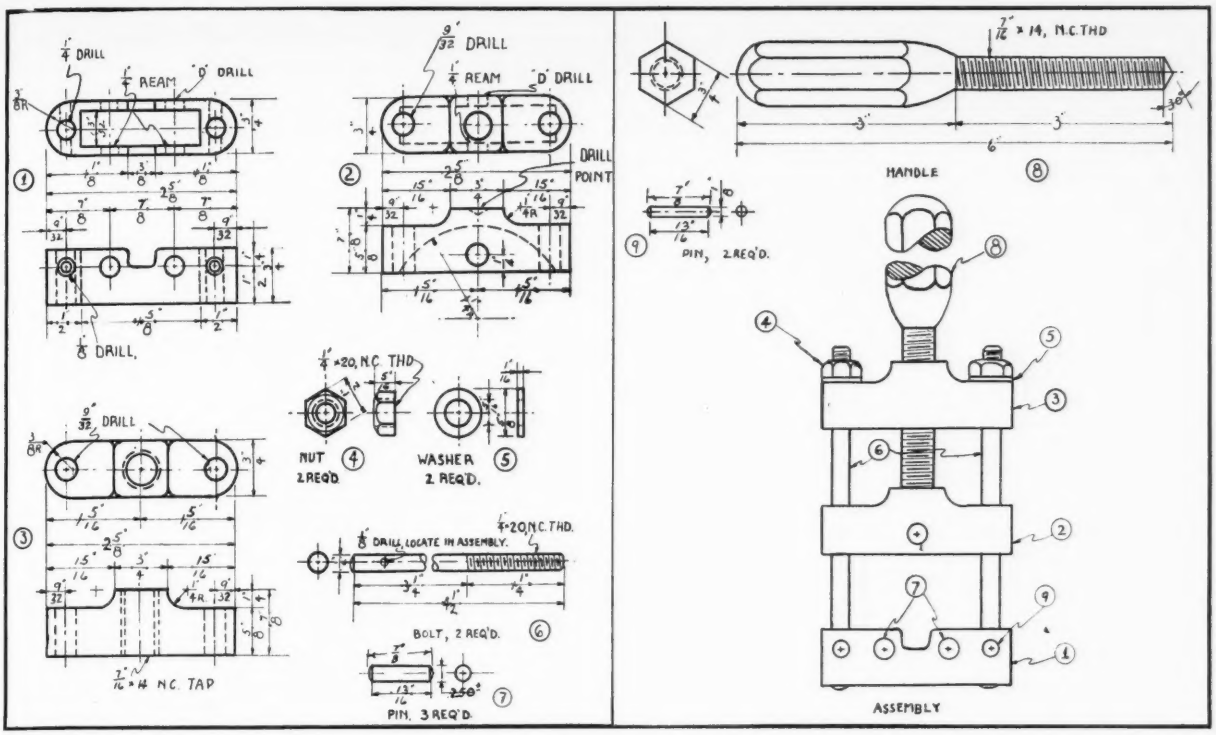
Students have had a lot of fun during the salvage operations prior to opening the shop. The project has met with such student approval that it will become a regular part of the industrial arts program.

The community blackout-driving course has already asked and received permission from the school board to hold engine instruction classes in this shop. This is an example of the extensive service that a set-up of this type can render, despite the small investment necessary.



Noise . . . . *(Continued from Page 3)*

tion. The pupil must be taught by example, lecture, and disciplinary measures that noise is unnecessary, unhealthy, and unproductive, that good work and marks are the result of quiet attention to the job at hand and that common courtesy demands a low voice, consideration of the feelings of others, and respect for the teacher, the school, and the principal. The teacher must bear in mind that his actions are always on display; that the pupil believes "if he can do it, so can I." The teacher who constantly yells can not expect a quiet class. *(Continued on page 23)*



Hand Knurling Tool

BY *Wallace I. Victoria*

A useful tool to save lathe set-ups and speed the completion of projects requiring knurling. The author is chairman of the drafting department, Queens Vocational High School, New York, N.Y.

THE hand knurling tool is used when the lathe is not available at the time or a lathe setup is inadvisable. The object is held in the bench vise and the tool wound around it.

To obtain the full depth of the knurl, the handle is tightened as the work progresses. To advance the knurl, side pressure is exerted as the tool is turned around the work.

This makes a fine auxiliary machine shop job and an added useful tool in the machine shop. Approximate time to complete: 20 hours.

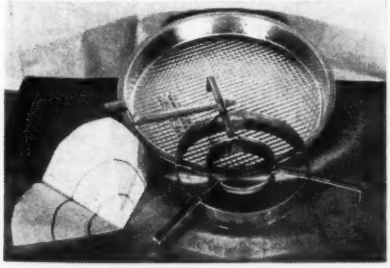
Shop operations include: turning, threading, milling and shaping, drilling, tapping, reaming.

Checkerboard Cake Mold

BY *Charles M. Rice*

This project calls forth the student's resourcefulness in using scrap materials. The author teaches at Western Washington College, Bellingham, Washington.

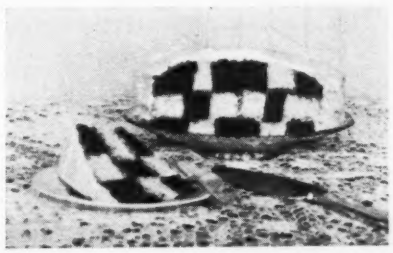
HERE is a project which suggests certain qualities considered desirable by instructors who endeavor to adjust such factors as pupil-interest, cost-of-materials, near-at-hand materials, practical uses, fair comparison with commercial products, range of pupil ability, instructional planning operations and the very important element . . . time-apportionment.



Although this cake mold is made by hand processes from parts of two tin cans, it may also be made from narrow widths of waste tin-plate with the aid of the proper metal-working machines.

The *procedure* is as follows: (1) determine the size of mother's cake tins; (2) form a paper template by drawing a line around one of the tins; (3) cut to shape; (4) divide the circumference into three (or more) equal parts by drawing circles on the template; (5) divide the template into *six* equal segments by folding; (6) place the template in the cake tin and select tin cans of proper size to match the circles on the template; (7) scribe a line *one inch* from the top of each can; (8) cut in from the opposite end of the cans and follow around the cans, roughly, with the tin snips, then trim carefully to the line after the parts have been removed; (9) cut three narrow strips and hem the edges to serve as supporting arms; (10) solder in place; (11) trim the arms to equal lengths and bend the ends downward to keep the mold properly centered in the cake tin.

When used, the mold only serves as a device for arranging the cake batter. As each tin is filled, the mold is removed to the next, and the order of placing the colored batter is alternated.



PIT Woodworking Project

BY *John P. Wantuck* AND *Andrew A. Moore*

TESTED INSTRUCTIONAL PROJECT

WITH the inauguration of the Fundamentals of Shopwork course as part of pre-induction training there have developed many problems in the selection of desirable work projects. Operating on crowded schedules which often limit these classes to but one shop period a day and faced with acute wartime shortage of materials, one must be sure that the acquisition of as many of the required skills and technics as possible be streamlined into a single undertaking. The fact that the bulk of the students taking this course have had no previous shop courses constitutes still another problem in the designing of a project. While it must be one that gives practice in and develops those skills deemed immediately essential, it cannot require, as do most of our conventional projects, a previous familiarity with shop skills, tools, or materials, such as would be possible with the regular technical student.

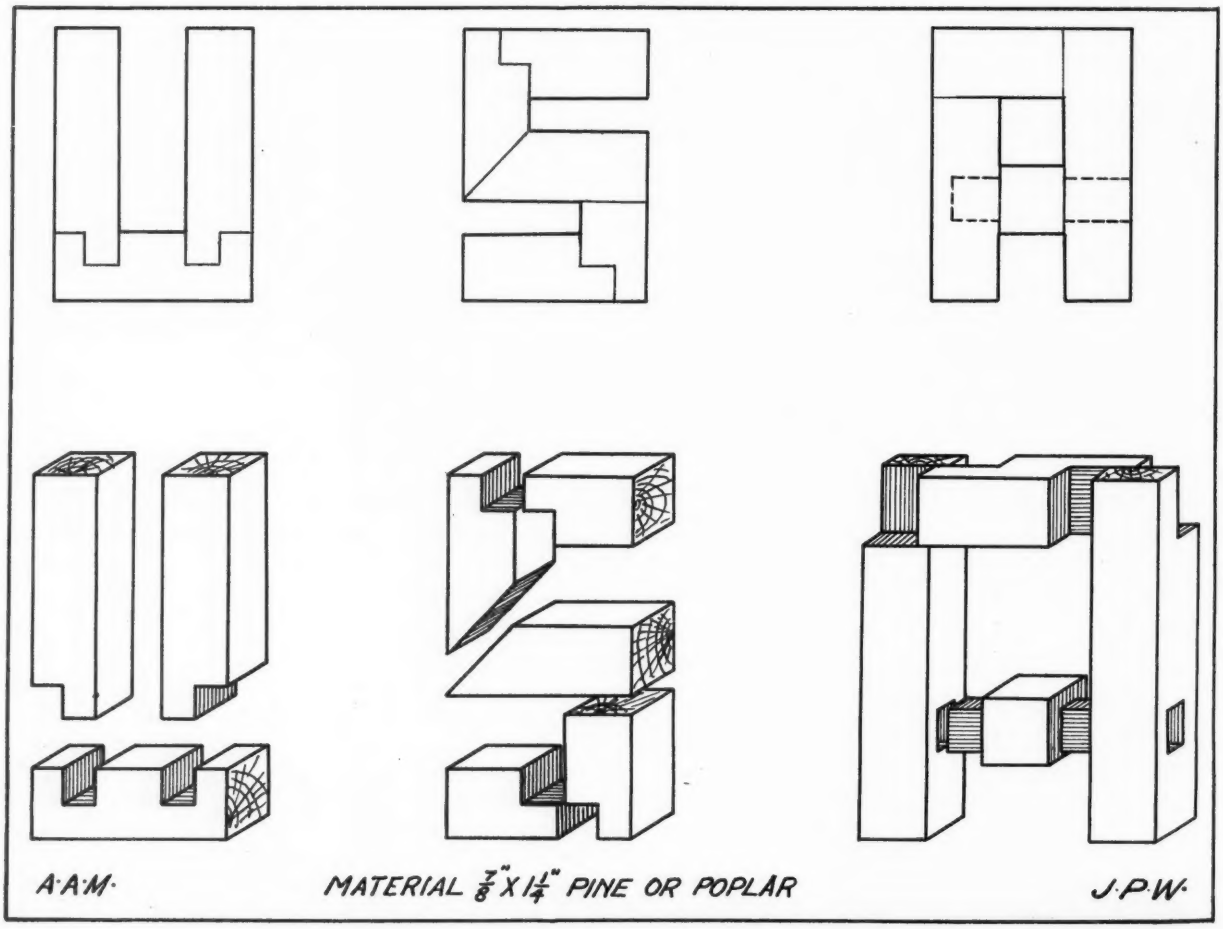
Here is a project expressly designed to meet the problems encountered in teaching the pre-induction course in Fundamentals of Shopwork, PIT 103. The authors teach at Senn High School, Chicago, Illinois.

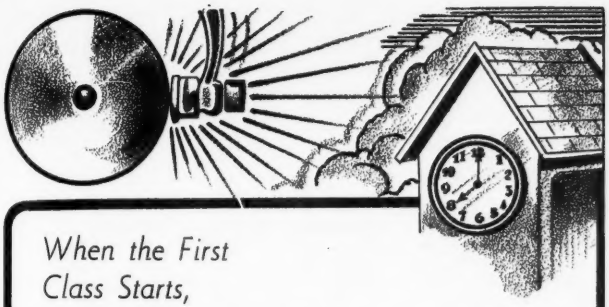
With these points in mind the accompanying project has been designed and utilized in the Senn High School of Chicago, Illinois. It was found that the operational skills of laying out, planing and squaring, joint making, and wood finishing (which constitute the major requirements set up in woodwork) could all be incorporated into this one single problem. Provided with 1¼" x ⅞" stock (pine, bass, or poplar) the student working from a previously executed drawing and work sheet proceeds to lay out those joints which when properly fitted and glued together constitute some meaningful group of letters. In the case of the popular choice of letters [U]nited [S]tates, 30" of stock is sufficient for both letters when made 5" high by 3½" wide. Utilization of the school name, club names, or personal initials, provides considerable opportunity for variety and ingenuity. Simplification of dimensioning results from having all joints lap to ½ the thickness of the stock used —except in the mortise-and-tenon joint.

The only requirement in the varied choices of letters and of constructional design is that all the essential joints, namely the butt, dado, lap, mortise and tenon, miter, and rabbet, be incorporated into the finished project.

Further practice in laying out as well as the acquiring of skill in the use of the plane and square comes through the making of a plaque on which to mount the letters when they are finished. The plaque is a piece of ⅝" stock planed and squared to size with a chamfer applied to the edge. Letters and plaque may then be finished in some contrasting manner which provides practice in wood finishing.

When finished the student has encountered an extensive array of desired experiences in a minimum of time and within a reasonable range of materials.



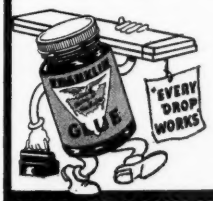


When the First Class Starts,

FRANKLIN

Liquid Hide GLUE *is ready!*

No waiting around, no time wasted. For this revolutionary liquid hide glue in ready-to-use form doesn't need mixing, heating or preparation of any kind. Eliminates chilled joints. Give your classes FRANKLIN, the glue the woodworking industry prefers.



Free **SAMPLE**

Write on your school letterhead, and test sample will be sent at once. No obligation.

THE FRANKLIN GLUE CO., Columbus, Ohio

THANKS TO YOU STARRETT TOOLS ARE IN GOOD HANDS

No one is more keenly appreciative of the contribution you have made and are making to our Country's vast precision production program than the makers of Starrett Precision Tools.

Without the knowledge and appreciation of truly fine tools that you have instilled, production would fall far short of the goals that have been set and met.

Our hats are off to the teachers of precision workmanship. We can best express our appreciation by promising you that Starrett Tools will always be worthy of those hands that develop their skill under your guidance.

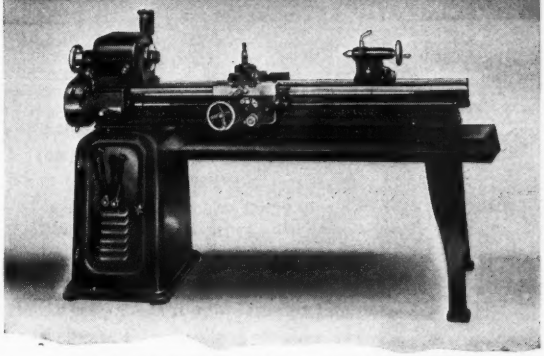
The L. S. Starrett Co., Athol, Mass., U.S.A.

World's Greatest Toolmakers

Precision Tools . . . Dial Indicators . . . Ground Flat Stock Hacksaws . . . Metal Cutting Bandsaws . . . Steel Tapes.

STARRETT TOOLS

SHELDON



Sheldon BBU-1242 WQ Precision Lathe

This quality 12 in. ball bearing tool room lathe is built for precision work and will retain its accuracy under long and hard usage. It has extra collet capacity (to 1" round), the finest precision ball or roller bearings obtainable, an improved heavy-duty, double wall apron with power cross feed; full quick change gears and full bowl headstock. Its improved SHELDON 4-speed, V-belt, lever-clutch operated, underneath motor drive is entirely enclosed in the pedestal leg and has anti-friction bearings. It is so designed that spindle belts operate through a standard 1-piece bed. This bed is bridge-braced with heavy cross girts and has hand scraped ways—2 V-ways and 2 flat ways.

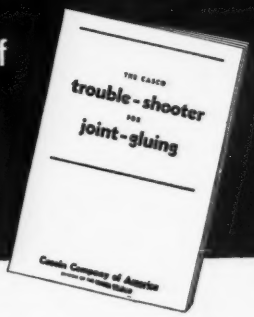
If interested in 10", 11" and 12" quality lathes be sure to see the SHELDON.

SHELDON MACHINE CO. INC.

4260 N. Knox Ave., Chicago, U.S.A.

FREE! "FIRST-AID" GLUING HANDBOOK

For Instructors of Advanced Woodworking Classes



● Written for inspectors and glue-room foremen in industry, the "Casco Trouble Shooter" for joint gluing is helpful as a practical text and reference book for vocational instructors—especially those teaching aircraft woodworking.

Subjects include: How to identify the cause of a poor glue joint; The mechanics of casein and resin glue; Common gluing faults and their remedies; Mixing, spreading, pressing and maturing procedures, etc. 22 pages. Easy to read.

Your copy gladly sent if you request on school letterhead.

CASEIN COMPANY OF AMERICA
DIVISION OF THE BORDEN COMPANY
350 MADISON AVENUE, DEPT. SS 4, NEW YORK, N. Y.

Demonstrating Alternating Currents

BY *Ralph O. Williams*

This teaching device can be used in pre-induction courses in radio and electricity to excellent advantage. The author teaches radio in the Vocational Aviation Mechanics Department, Western Michigan College of Education, Kalamazoo, and is a member of the Institute of Radio Engineers, being listed by the Institute as a Consulting Engineer. He is an active (pre-war) radio amateur with call letters W8AJC, a member of the American Radio Relay League, and holds commercial operator's license for both radiotelephone and radiotelegraph, as well as an amateur Class A license.

MAGNETS suspended like pendulums from the ceiling of the classroom and free to swing in and out of their respective coils of wire as shown in Figure 1 make an excellent device for demonstrating induced currents and alternating current phenomena.

A practical working knowledge of alternating current fundamentals is a prerequisite to any kind of a future in electricity ranging from power machinery to electronics, and should be acquired early by the student studying basic electricity or radio. The mathematical explanation of induced, periodic, and alternating currents involves trigonometry and other difficult concepts such as rates of change of rates of change which are new to the shop student and not easily grasped without something tangible for reference. The electron theory of matter and the explanation of all electrical phenomena on the basis of static or moving electrons stirs the imagination and helps one build up mental pictures of the action that takes place in electric circuits. The system of swinging magnets herein described is the result of an effort to produce an alternating current of good wave form and with a frequency so low that current changes could easily be observed on a galvanometer.

Construction of the Apparatus

The equipment shown in figures 1 and 10 consists of two identical magnets and their supports arranged so they can swing in and out of identical coils of wire which in turn can be connected in a number of ways for various demonstrations. The alternating currents produced by the apparatus must have a period of great enough length so the movement of the galvanometer needle can easily be followed by the eye and the oscillations timed by the second hand on an ordinary watch. A pendulum length of about seven feet has been found to be a satisfactory minimum and corresponds to about 20 oscillations per minute.

Obtaining material.—Material for the construction of the apparatus can be acquired from the junk pile in the corner of most any radio service shop or may be solicited from the public in behalf of the school. A small advertisement in the local paper brought in 25 old radio sets at Western Michigan College which not only supplied parts for the swinging magnet experiments but many other things useful about a radio or electrical laboratory. Suitable permanent magnets can be obtained from old magnetic loudspeakers as shown on the left in figure 2. Old electrodynamic loudspeakers contain field coils in a variety of sizes which, when removed from the speaker, make ideal units for the swinging magnet demonstrations. Typical salvaged speakers of this type are shown on the right in figure 2. In the foreground is a group of coils taken from old electrodynamic speakers. It is desirable to have two identical coils; these can be obtained from two speakers of the same kind. If two coils having the same characteristics are not available, new coils can be wound with the wire from the speakers.

Fig. 2.—A group of old loudspeakers from which coils and permanent magnets were salvaged. Typical coils and a magnet are in the foreground.

The permanent magnets.—The most common variety of magnet found in old speakers is the one shown in the foreground of figure 2 and suspended free to swing in the coil in figure 3. These magnets are about 3″ across from pole to pole and about 4″ long. It is desirable to have the magnet as large as possible so it will swing in and out of a large coil. It is also desirable to have a heavy magnet so it will swing for a longer time during demonstrations. If several magnets are available, select two of exactly the same physical dimensions and having strong fields. Strength of field can be tested by the amount of induced current produced in a coil, the stronger magnet producing the larger amount of current. If means are

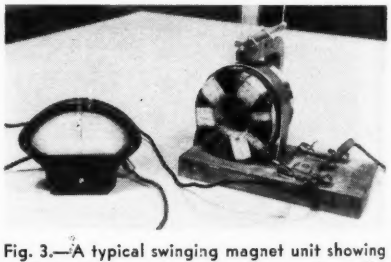


Fig. 3.—A typical swinging magnet unit showing method of suspension and coil mounting. The galvanometer is connected to the coil and will indicate the direction and magnitude of the currents generated.

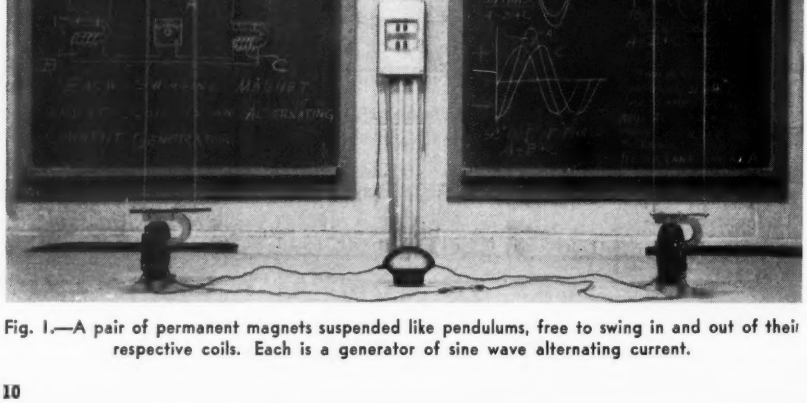


Fig. 1.—A pair of permanent magnets suspended like pendulums, free to swing in and out of their respective coils. Each is a generator of sine wave alternating current.

available both magnets should be remagnetized to as high a degree of magnetization as possible. When demonstrating Lenz's Law it is especially important that the swinging magnet have a strong field.

Suspending the magnets.—The magnets should be suspended from the ceiling of the classroom on strong thread or "number six cord" so they just clear the surface of the demonstration table. Because of the tendency of the magnets to rotate or swing in an elliptical path it has been found desirable to suspend them by four threads running through eyelets in the ceiling spaced as shown in figure 4. Because of the weight distribution and location of center of gravity of the magnet a small wood dowel (child's tinker-toy stick) about eight inches long is secured to the magnet so one end projects out over the heel of the magnet. Supports are made from the ends of the dowel (see figure 3). The

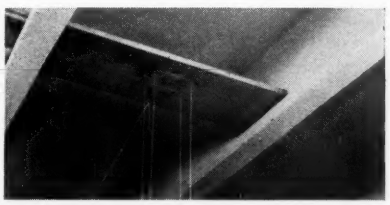


Fig. 4.—Four screw eyes in a board attached to the ceiling through which pass cords from the magnet form a convenient method of suspension. The cords are not tied to the screw eyes but are free to slide through them for adjustment of the magnets.

height of the magnet above the table can be adjusted by winding the supporting strings around the doweling to which it is tied.

The coils.—Coils of wire taken from the fields of electrodynamic loudspeakers fall into two general classes, those having high resistance and those having low resistance. High-resistance coils operate from high voltage and low current, and have resistance ranging from 1000 to 3000 ohms. Low-resistance coils are less common and the best ones come from speakers having six-volt fields and requiring about one ampere of current. Their resistance will be about six ohms. Both high and low resistance coils are designed to produce the same strength of field and so have about the same number of ampere-turns. No instructions for winding coils are given because of the easy availability of coils from old speaker fields. These coils are nicely constructed and need no modification, except mounting. The size of the coil in relation to magnet size should be as shown in figure 3. It is desirable to have two sets of coils, one of high resistance and one of low resistance. If possible the coils of each set should be identical, that is, taken from like speakers. If identical coils cannot be secured, coils having approximately the same resistance should be used. There is a wide latitude in the types of coils and galvanometers that can be used. Successful demonstrations have been made with galvanometers ranging in sensitivity from ½ to 15 milliamperes full-scale deflection and coils ranging in resistance from 5 to 3000 ohms.

Mounting the coils.—Coils should be mounted on small wood bases equipped with fahnestock clips for easy connections. A satisfactory type mounting is shown in Fig. 3. The metal clamp holds the coil securely to the base upon which are fastened the terminals. *Caution:* When using clamps to mount coils be sure that there is not a complete electrical circuit around the clamp. If the clamp forms a single turn about the coil the induced currents will spoil the effectiveness of the unit. There must not be a complete electrical circuit in the clamp.

The galvanometer.—The galvanometer is used as the current indicating device and should have a hand that comes to rest in the center of the scale for zero current. The hand should be large enough to be easily visible from a distance of a few feet. Current sensitivities ranging from ½ to 15 milliamperes are satisfactory. The internal resistance and full-scale current determine the amount of power taken from the circuit to run the galvanometer which in turn controls the length of time the magnet will swing before coming to rest. If it is desired to have the magnet swing for as long a time as possible, a very high resistance galvanometer should be used.

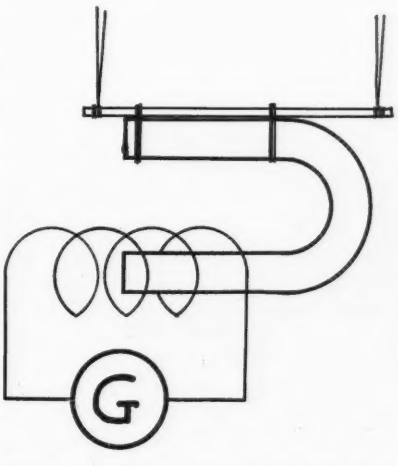


Fig. 3-A.—Schematic diagram of coil and galvanometer connections in Fig. 3.

If on the other hand a low resistance galvanometer only is available, it will require considerable power for its operation and will decrease the amplitude of the successive oscillations of the pendulum at a rather high rate; low resistance meters should be used with low resistance coils. If only one galvanometer is available, use it, of course; but if there is a possibility of selection a few experiments will indicate the most suitable one.

Suggested Demonstrations

1. *Generation of alternating current.*—Use only one swinging magnet and coil. Connect as shown in figure 3-A. When the magnet is at rest it should assume a position half way into the coil as shown in figure 3 if the best wave form is to be produced. The amplitude of oscillation should be kept low, the magnet being given a maximum swing of about two inches to start it. As the magnet swings in and out of the coil, alternating current will be produced and indicated by the galvanometer. Maximum current is generated when the lines of force from the magnet are cutting the coil at the highest rate, that is, middle of swing. This point corresponds to minimum *rate of change* of current! The minimum current is produced when the magnet is at either end of its swing as indicated by the hand of the galvanometer returning to zero. However it is to be noted that the hand does not remain at zero but travels through zero at a high speed showing that although the current is zero the rate of change of current with time is maximum at the instant the current passes through zero! It can be observed also that the frequency of the alternating current is independent of amplitude; amplitude being a function of the rate of cutting lines of force while frequency depends on the period of oscillation and is controlled by the length of the pendulum.

2. *Direction of induced currents.* (Left-hand rule).—Here a discussion of direction of current flow should take place and the students' attention called to the difference between the conventional direction due to Franklin, that is, from positive to negative, and the direction of electron flow through solids and vacuums, from negative to positive.

If the polarity of the galvanometer is marked the direction of current will be indicated by the deflection of the needle. With the apparatus connected as in figure 3-A it can be shown that the hand rules are true. In explaining the hand rules it is necessary to make a statement about relative motion of the conductor with respect to the magnet,

otherwise confusion may result. The left-hand generator rule states that with the thumb, first, and middle fingers all arranged at right angles to each other the middle finger points in the direction of electron flow when the first finger points in the direction of the magnetic flux (*N* to *S*) and the thumb points in the direction of motion of the conductor in the field.

3. *Lenz's Law for induced currents.*—Simply stated Lenz's Law points out that *the direction of an induced current is such that its magnetic field resists the motion producing it.* This can be demonstrated with a single swinging magnet connected to a key or switch as in figure 5, so that when the key is closed the coil is short-circuited.

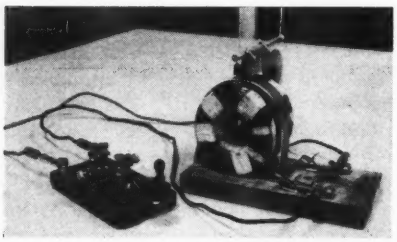


Fig. 5.—A swinging magnet unit consisting of coil and a telegraph key for a short-circuiting switch. This connection is used to demonstrate Lenz's Law. The swinging magnet is brought quickly to rest when the key is closed.

If the magnet is started swinging with the key open, it will continue to swing for several minutes with little visible change in amplitude. If however the key is closed so the induced currents are allowed to circulate in the coil, the oscillations will be quickly damped out and the magnet will come to rest abruptly showing that the induced field opposes the field inducing it. The illustration shows a six-ohm coil and telegraph key. If the permanent magnet is strongly magnetized, there will be only four or five oscillations before the magnet comes to a comlete stop!

4. *Generator and motor.*—Two swinging magnets and coils are used and connected as shown in figure 6; a meter is not used in this experiment. Both pendulums are adjusted to approximately the same length. The apparatus looks like figure 1 less the meter. Low resistance coils are recommended for this experiment because of the high response although high resistance coils may be used.

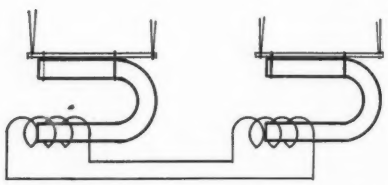


Fig. 6.—Method of connecting two swinging magnet units together to demonstrate motor and generator action. When so connected movement of one magnet will generate current which is transmitted to the other causing it to move. It is then the motor.

Swinging one magnet in its coil will start the other swinging and they will continue to swing in step, one acting as the motor and the other as the generator. When both coils are in motion either one may be stopped but it will start again, showing that either unit can be used as motor or generator. Direction of swing can be reversed by reversing the connections between the two coils. Both magnets can be brought to rest by short-circuiting the line between the coils again demonstrating Lenz's Law. The adjustment of the length of suspension needs to be only approximately the same for the two magnets since the reactions between them is so great that the motor will be held in step with the generator by "brute force." The magnets may be made to swing by inserting a key and battery in the line. If the key is held closed the magnets will be repelled entirely out of the coil and stand out as though being pulled by an invisible hand.

5. *Phase relations and addition of alternating currents.*—Connect apparatus as shown in figure 1, and adjust pendulum length so the periods are very nearly the same. It is desirable to have them exactly the same. The two coils are connected in series with each other and a galvanometer as shown on the black board in the photograph.

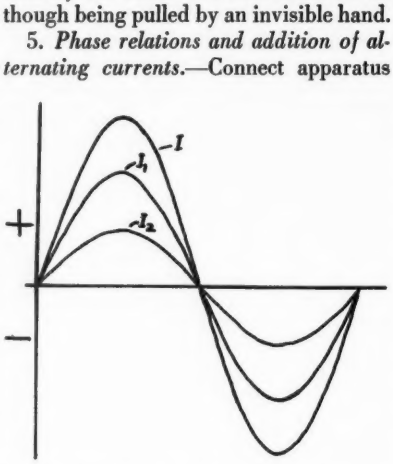


Fig. 7.—The large alternating current wave I is the resultant of the addition of the two inphase currents I_1 and I_2.

Inphase Operation: When both magnets are started to swing at the same time and in the same direction they are said to be *inphase* and their currents add. If the currents have the same amplitude the peak current produced will be twice the current of one generator. If they have different amplitudes as a result of swinging through different arcs the currents will add according to their values, the total being the sum of the individual currents (see figure 7).

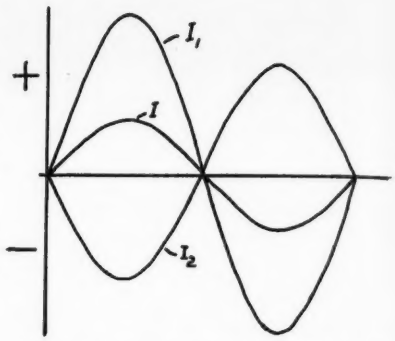


Fig. 8.—The currents I_1 and I_2 are 180° out of phase and add algebraically to produce the resultant current I. If I_1 and I_2 had been of equal magnitude the resultant current would have been zero.

180° out-of-phase operation: If the magnets are started to swing at the same time but in opposite directions and if the currents produced are equal in magnitude the resultant current will be zero since one coil is producing positive current while the other is producing current in the opposite direction and cancellation takes place. On the other hand if the magnets are started to swing at the same time and in opposite directions but with different amplitudes, the currents will add algebraically and the resultant current will take the sign of the larger and its amplitude will be the difference between the amplitudes of the individual currents as shown in figure 8. In all cases the resultant current is indicated by the deflection of the galvanometer.

90° out-of-phase operation: To secure 90° phase difference one magnet must be started before the other. Both magnets must be pulled back ready to start swinging; the first is released and when it reaches the bottom of its swing the

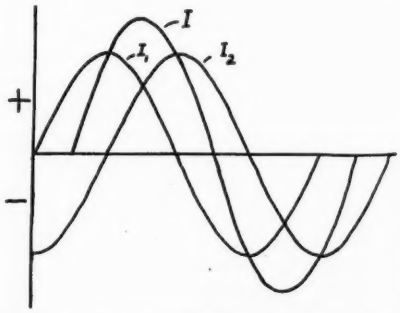


Fig. 9.—Two alternating currents I_1 and I_2 of equal magnitude but 90° out of phase add algebraically to produce the resultant current I. It is the resultant current that is indicated by the galvanometer in the experiments.

Training For War Production
Requires GOOD TOOLS
Write for Catalog No. 34 showing STANLEY TOOLS for all School Shops . .
STANLEY TOOLS
CATALOGUE No. 34
FOR SHEET METAL SHOPS
Hammers, Chisels, Punches, etc.
FOR AUTOMOBILE SHOPS
Body and Fender Tools, Hammers, Chisels, Punches, Screw Drivers, etc.
FOR MACHINE SHOPS
Hammers, Rules, Chisels, Punches, Levels, etc.
FOR FORGE SHOPS
Anvil Tools, Tongs, Hammers, etc.
Visual Teaching Aids and Project Plans at cost.
STANLEY TOOLS
DIVISION OF THE STANLEY WORKS
Educational Dept., New Britain, Conn.
1843 STANLEY 1943
FOR WOODWORKING AND FARM SHOPS
The most complete line offered by one manufacturer.
FOR ELECTRICAL SHOPS
Hammers, Bit Braces, Bit Extensions, Screw Drivers, etc.

JUST OUT

NEW ALLIED 1943 BUYING GUIDE

FREE—SEND FOR IT NOW!

EVERYTHING YOU NEED IN RADIO AND ELECTRONICS FOR WAR TRAINING

Allied's Educational Division has helped hundreds of military and civilian schools plan and carry out their training projects. The new, FREE Allied 1943 Buying Guide places everything in Radio and Electronics at your fingertips . . . books, diagrams, kits, test equipment—over 10,000 items to meet every Radio Training need! Write our Educational Division.

• USE THESE VALUABLE NEW ALLIED TRAINING AIDS •

DICTIONARY of RADIO TERMS
No. 37-751
Simple definition of radio terms . . . 10c

RADIO CIRCUIT HANDBOOK
No. 37-753
Practical data and schematic diagrams. 10c

RADIO DATA HANDBOOK
No. 37-754
Formulas, charts and technical data 25c

*Write for Quantity Quotations

ALLIED RADIO CORP.
833 W. Jackson Blvd., Dept. 30-D-3, Chicago

·ALLIED RADIO·

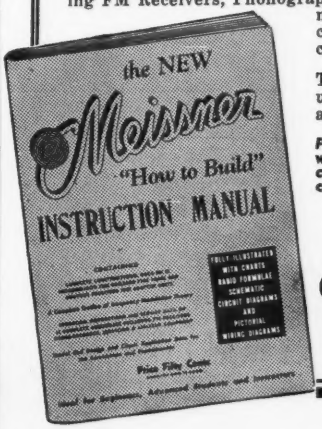
Here's the RADIO MANUAL YOU MUST HAVE!

THE IDEAL RADIO MANUAL FOR INSTRUCTORS

THE new Meissner "How to Build" Radio Instruction Manual, edited by expert Radio Engineers is fully illustrated with charts, Radio Formulae, Schematic Circuit Diagrams and Pictorial Wiring Diagrams. Contains a complete outline of Frequency Modulation Theory.

Construction data on 22 kits for building radio receivers and adapter units, with operating instructions and servicing data on over a dozen complete assemblies, including FM Receivers, Phonograph-Recorder, and radio equipment, also gives you valuable coil design and circuit application data.

The Radio Instruction Manual for the beginner and the advanced student training.


the NEW
Meissner
"How to Build"
INSTRUCTION MANUAL
FULLY ILLUSTRATED WITH CHARTS RADIO FORMULAE SCHEMATIC CIRCUIT DIAGRAMS AND PICTORIAL WIRING DIAGRAMS
Price Fifty Cents

Price, only 50 cents post paid anywhere in the U.S.A. (seventy-five cents in Canada). Send for your copy today!

Meissner
MT. CARMEL, ILLINOIS
"PRECISION-BUILT PRODUCTS"

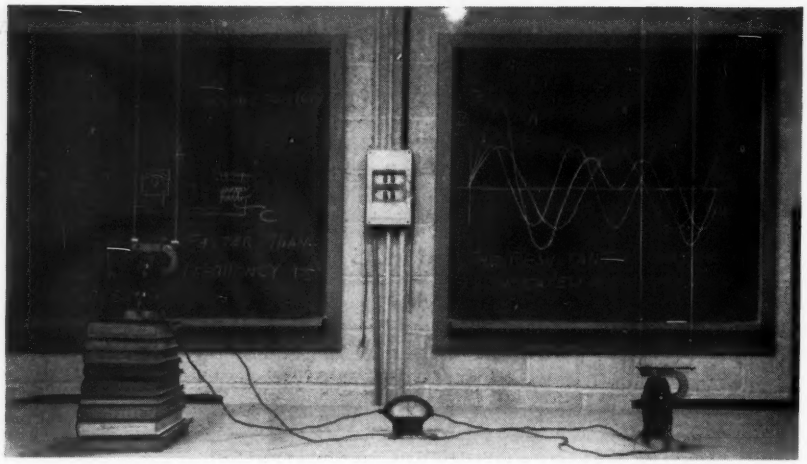


Fig. 10.—Two swinging magnets, the period of one made shorter than the other by winding the supporting cords around the stick on the magnet. The coil is raised by a stack of books. When the magnets are in motion alternating currents of two different frequencies are generated and add as shown on the black board. The irregular motion of the galvanometer indicates the presence of the sum and difference frequencies.

second is released; the magnets are then swinging 90° out of phase. The resultant current will not be inphase with either, but half way between the two currents as shown in figure 9. This third current is equal to the algebraic sum of the currents of the individual generators and it is this current that is registered by the galvanometer.

Regardless of the phase relation between the two generators the galvanometer shows the algebraic sum of the currents which if plotted on graph paper would be a third sine wave displaced from the other two a certain distance, depending on the phase relations.

6. *Beat frequencies.*—Previous experiments demonstrated phase relations between currents of the same frequency. Now it is desired to demonstrate the effect of the addition of alternating current of different frequencies.

When two alternating currents of different frequencies are mixed in a circuit two other frequencies are produced, one equal to the sum and one equal to the difference of the original periods. If the length of one pendulum is decreased so there is a noticeable difference in its period and the two generators are connected in series with galvanometer as shown in figure 10 the instrument will indicate by the movement of the hand the sum and difference frequencies.

The right-hand black board in figure 10 illustrates two alternating currents of slightly different frequency and shows the resultant alternating current. When both currents are in phase they add to produce a current of large amplitude;

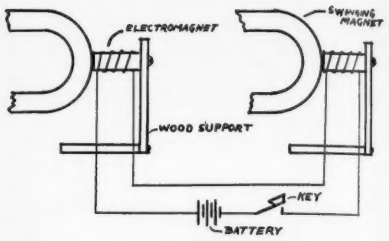


Fig. 11.—A pair of small electromagnets so arranged and connected that it is possible to release both swinging magnets at the same instant. When the key is opened the magnets are released.

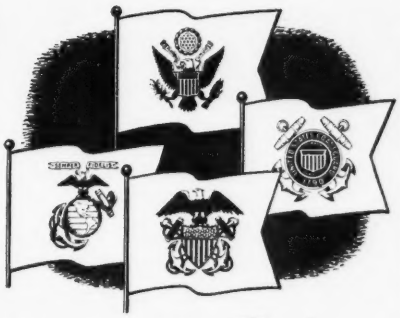
when they are 180° out of phase they cancel to produce zero current. At all other times there is current which is the algebraic sum of the instantaneous values of the two original currents. The galvanometer hand has maximum swing when the currents are in phase and comes to rest for the instant that cancellation takes place. The rest of the time it is oscillating back and forth at the difference frequency and at the same time vibrating at a frequency equal to the sum of the two original frequencies. The action can be predicted by carefully observing the curve of the resultant on the black board in figure 10.

The above beating of two frequencies illustrates how a third frequency is generated in a superheterodyne radio receiver, where the signal coming in over the antenna is heterodyned (beat against) by the signal from the local oscillator to produce a sum and difference frequency one of which is the intermediate frequency of the receiver and is the result of mixing the two signals in the first detector.

(Continued on page 19)

HIGGINS AMERICAN DRAWING INKS
Precision Inks for Precise Performance
From the steamy dampness of the tropics to the icy dryness of the arctic, experienced draftsmen insist on Higgins American Drawing Inks. For they know they can depend on the precise performance of Higgins Inks under all working conditions.
For more than 63 years Higgins American Drawing Inks have been winning world-wide respect for their superior qualities — for free flow and sharp surety of line. Draftsmen know that with reasonable care Higgins American Drawing Inks retain their qualities of precision performance unless actually exposed to freezing.
Available in a complete color range.
HIGGINS
AMERICAN INDIA INK
HIGGINS INK CO., INC.
271 NINTH ST., BROOKLYN, N. Y.

UNDER 4 FLAGS



RIDER BOOKS *are training Radio men*

In addition to use as texts in all the armed services, Rider Radio Books are also found in leading libraries and famous technical schools; to mention a few: Georgia Tech., Univ. of Pennsylvania, Northwestern Univ., Virginia Polytech., Manhattan College, M I T, Univ. of Delaware, Carnegie, Duke, Harvard, Syracuse and Univ. of Alabama.

THE CATHODE RAY TUBE AT WORK
Accepted authority on subject.....338 pp.—$3.00
FREQUENCY MODULATION
Gives principles of FM radio.....138 pp.—$1.50
SERVICING BY SIGNAL TRACING
Basic method of radio maintenance. English ed. 360 pp.—$3.00; Spanish ed. 385 pp.—$3.50
THE METER AT WORK
An elementary text on meters.....152 pp.—$1.50
THE OSCILLATOR AT WORK
How to use, test and repair.....243 pp.—$2.00
VACUUM TUBE VOLTMETERS
Theoretical and practical.....179 pp.—$2.00
AUTOMATIC FREQUENCY CONTROL SYSTEMS
—also automatic tuning systems.....143 pp.—$1.25
AN-HOUR-A-DAY-WITH-RIDER SERIES
Provide foundation for advanced study on "Alternating Currents in Radio Receivers," on "Resonance & Alignment," on "Automatic Volume Control," on "D-C Voltage Distribution." Hard bindings.....90c each
A-C CALCULATION CHARTS
Faster than a slide rule .....160 pp.—$7.50

JOHN F. RIDER, Publisher, Inc.
404 FOURTH AVENUE • NEW YORK CITY
EXPORT DIV.: ROCKE-INTERNATIONAL ELEC. CORP.
100 VARICK STREET, NEW YORK CITY. CABLE: ARLAB

RADIO PARTS HEADQUARTERS!

Quick Deliveries!

Why waste time and money? Lafayette has complete stocks of radio, sound and electronic parts and equipment.

Just one order to Lafayette secures everything you need . . . two big warehouses for faster deliveries!

RADIO KITS DESIGNED FOR TEACHING REQUIREMENTS or made up to your own specifications.

TECHNICAL BOOKS in radio, sound, electronic and associated fields. Order from Lafayette's complete stocks. Lowest prices and immediate deliveries.

FREE—130 page indexed catalog . . . your quick reference guide to everything you need in radio, sound and electronic equipment. Write for your FREE COPY today. Address 901 West Jackson Blvd., Chicago, Ill. 4D3

LAFAYETTE RADIO CORPORATION
901 W. Jackson Blvd., Chicago, Ill. • 265 Peachtree St., Atlanta, Ga.

Of course you are planning to work this summer

Why Not Come to Detroit?

EARN in Essential War Industries while you LEARN in Wayne University

Detroit's Great Arsenals of Democracy are providing essential summer work for teachers who qualify with cash scholarships of from $180 to $500. A splendid opportunity to further your education by attending Wayne University—to enrich your teaching background with industrial experiences in Detroit's great plants—to earn while you learn.

Teachers under this program attend classes out of shift. Graduate and undergraduate program—main session June 21 to Aug. 13—post session Aug. 16-17—approved Smith-Hughes courses—aviation workshop center.

Write for circular of information.

WAYNE UNIVERSITY

Department of Vocational Education
***467 West Hancock,* DETROIT**

Practical Textbooks

Examine Them on APPROVAL

These modern texts have been especially prepared for school use. You can employ them to excellent advantage in your Victory Training program as well as your regular program. An examination will convince you of their suitability to your classroom needs. Any books sent for 30 days ON APPROVAL inspection subject to our educational discount if retained.

Dunwoody Arc Welding Unit	$1.25
Dunwoody Gas Welding Unit	1.25
Aerial Navigation	0.75
Mechanical Drawing	2.00
How To Plan A House	4.50
How To Remodel A House	4.75
Fundamentals of Electricity and Workbook (PIT)	2.50
Fundamentals of Machines and Workbook (PIT)	2.50
Fundamental Shop Training and Workbook (PIT)	2.50
Plane Trigonometry Made Plain	2.75
Metallurgy	2.50
Shipbuilding Blueprint Reading	3.00
Tool Design	4.50
Machine Trades Blueprint Reading	2.00
Plastics	3.00
How To Read Electrical Blueprints	3.00
*Flight—First Principles	2.50
*Flight—Aviation Engines	3.25
*Flight—Meteorology and Aircraft Instruments	3.25
*Flight—Construction and Repair	2.50
Machine Shop Work	3.50

*Note: These books have been listed in Leaflet No. 63 issued by U. S. Office of Education

(TEAR OFF HERE AND MAIL TO US)

AMERICAN TECHNICAL SOCIETY
Drexel Ave., at 58th St., Chicago, Dept. HS—158

Please send the following texts for 30 days ON APPROVAL examination. I will either return them at the end of that time or remit less your educational discount.

Name

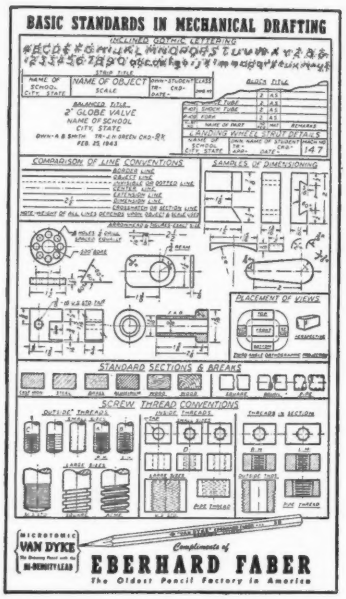
School

School Address

. . . news from INDUSTRY

For items listed in this column, readers may address the firm named or write to News from Industry Dept., SCHOOL SHOP, Box 100, Ann Arbor, Michigan.

Drafting Standards Chart Offered by Eberhard Faber



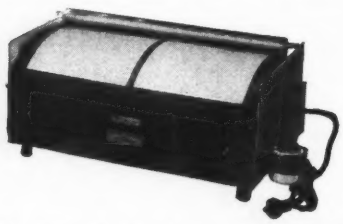
"Basic Standards in Mechanical Drafting" is the title of a new wall chart offered to drafting instructors by Eberhard Faber Pencil Co. The chart, measuring 16½" x 27½", is intended for wall hanging, and is treated so that it can be cleaned with a damp cloth.

Shown on the chart are standards for lettering, title blocks, lines, dimensions and dimensioning, sections and breaks, and internal and external threads.

Copies may be had without charge by addressing Eberhard Faber Pencil Co., Dept. G, 37 Greenpoint Ave., Brooklyn, N. Y., or SCHOOL SHOP.

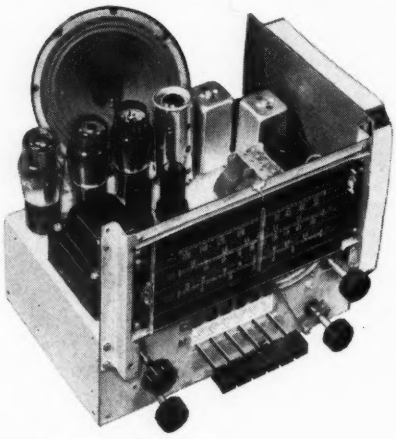
Peck & Harvey Introduce New 'Spee-Dee' Printer

For making low-cost blueprints and black-and-white prints, Peck and Harvey, Chicago, have developed their new "Spee-Dee" printer. Prints can be made in half-a-minute, with exposure time frequently as low as 20 seconds.



The "Spee-Dee" printer is made in two sizes, 12" x 18" (illustrated) and 18" x 24", each with oversize printing surface to prevent overlapping of prints in the machine.

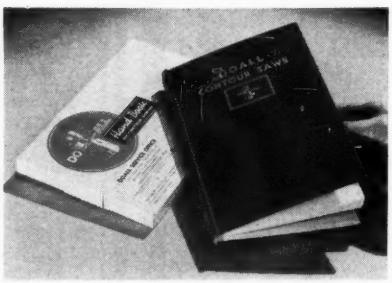
The cost of the "Spee-Dee" printer is low, the larger machine, with timer, selling for $65.00. Initial supply of print paper and chemicals costs $4.00. Prints are said to cost less than 1½c per square foot. For further details address Peck and Harvey, Dept. SS, 4325 Addison St., Chicago, or SCHOOL SHOP.



Meissner Offers New Radio Training Kit

For radio training in schools, Meissner Manufacturing Co., Mt. Carmel, Ill., offers a new 9-tube radio kit. The kit, suitable for advanced work, is a three-band AC superheterodyne with automatic push-button tuning, push-pull audio, 6-inch electrodynamic speaker, automatic volume control, variable tone control, and connections for phonograph, television, and FM.

The kit comes complete with all parts and tubes. The cabinet is optional at extra cost. Further data may be had by writing SCHOOL SHOP or the manufacturer.



Free 265-Page Book on Doall Machining

A new 265-page book covering the technics of Doall contour sawing is offered free to instructors by the Doall Service Office, Dept. SS, 1201 Thacker St., Des Plaines, Ill.

The book, *Doall Contour Sawing*, gives comprehensive study to the art of contour machining, its cutting tools, and the Doall training program. Over 80 percent of the book is devoted to pictures, diagrams, and charts showing the details of machining ferrous and nonferrous metals, alloys, plastics, wood, rubber, etc.

A 44-page section gives specific information on machine tools and machine-shop practice for the student. Copies of the book may be had without charge by writing SCHOOL SHOP or the Doall Company at the above address.

Allied Releases 1943 Buying Guide

Allied Radio Corporation, Chicago, has just released its new 1943 buying guide covering radio and electronic supplies. Emphasis is placed on needs of schools and radio training programs. Included are detailed listings of transformers, resistors, condensers, rheostats, switches, rectifiers, tubes, tools, wire and cable, and all types of equipment and kits for classroom, laboratory, and shop training in radio and code practice.

A technical book section is also included listing all latest books on the subject of radio. Allied's own books on radio are also listed. The buying guide is free to instructors writing SCHOOL SHOP or the company, 833 W. Jackson Blvd., Chicago.

Atlas Press Co. Coolant Pumps

For use with Atlas and other machine tools, Atlas Press Co., Kalamazoo, Mich., has introduced two new portable coolant pumps. Capacities of the pumps meet maximum-flow demands of most lathes, drill presses, millers, grinders, and other tools.

Pumps are of centrifugal design, increasing rigidity, lengthening service life, and insuring smooth, troublefree performance. Complete coolant systems may be assembled by selecting feed and return units available.

For complete data ask for Catalog C43, Atlas Press Co., 1836 N. Pitcher St., Kalamazoo, Mich.

Behr-Manning Offers Abrasive Instruction Sheets

A series of practical instruction sheets on abrasives is being offered shop teachers by Behr-Manning, Troy, N. Y. A folder is provided in which to keep the sheets, which contain information on abrasives—their types and uses, etc. The series will be sent without charge to any shop teacher requesting it. Address SCHOOL SHOP or Behr-Manning, Dept. SS, Troy, N. Y.

Simonds Publishes Saw and File Manuals

Two booklets on the use and care of saws and files are offered by Simonds Saw and Steel Co., Dept. SS, Fitchburg, Mass. *Facts for Mechanics* tells how to get the best work from hack saw blades, band saw blades, and files. *The Care and Use of Circular Saws* presents 88 pages of data on use and sharpening of circular saw blades.

No charge is made for the booklets. They may be had on request from SCHOOL SHOP or from the company.

SHOP BOOKS

GENERAL PRINTING . . .

See this book! Called by instructors who have seen it the *"best book published on printing."* $1.60. Cleeton & Pitkin.

ELECTRICITY . . .

General Shop Electricity: Fundamentals of electricity. 80c. Dragoo & Dragoo. *Projects in Electricity:* $1—Collings.

METALWORK . . .

General Shop Metalwork: For beginners in Bench, Sheet, Art and Ornamental Metal or Wrought Iron Work. 60c. Dragoo & Dragoo.

WOODWORKING . . .

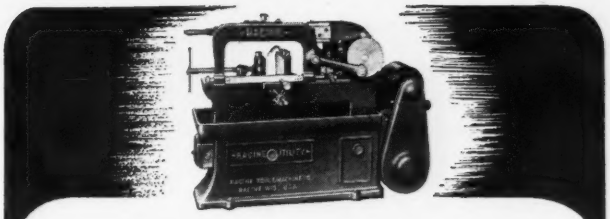
General Shop Woodworking: 2nd edition. Revised and enlarged. 80c. Fryklund and LaBerge.

DRAFTING . . .

General Drafting: 1st year course $1. Fryklund & Kepler. *Drawing Aptitude Test:* 7th to 10th grade mechanical drawing classes. 35c. Mitchell. *Sign & Poster Textbook: Cloth $1.* Harshberger.

Sent on Approval. Write

McKNIGHT & McKNIGHT
BLOOMINGTON, ILLINOIS



RACINE

METAL CUTTING MACHINES

Standard for Higher Quality and Greater Precision

Precision built of select quality materials, RACINE SAWS are designed and built for efficient, fast, accurate metal cutting operations. • "Utility" model can be had in either Wet or Dry Cut types. Hydraulically fed and operated, these machines make training easy. Simple control devices—anyone can operate. Capacity 6" x 6". • Guarded for complete safety and built for long, economical operation. • The modern saw for general purpose metal cutting. Other models up to 20" x 20" capacity are also available in RACINE'S complete metal cutting machine line.

Write today for complete literature and prices. Address Dept. SS.

STANDARD FOR QUALITY AND PRECISION

RACINE TOOL AND MACHINE CO.
RACINE, WISCONSIN • U. S. A.

Electrical Equipment And Apparatus For Pre-Induction Courses

Universal Scientific Company will gladly recommend apparatus to meet any requirement that you may have. Our Technical Department will cooperate with you in helping solve your electrical equipment problems.

We solicit your inquiries regarding our liberal discounts to educational institutions on our special electrical instruction equipment.

We have developed new apparatus for student construction projects covering topics stressed in **PIT-101, "Fundamentals of Electricity."** For example, our line includes equipment for the following student construction projects:

A C Motors—All types including single and polyphase	D C Motors—All types
A C Alternators or Generators—single and polyphase	D C Generators—All types
Dynamotors	Magnetos
Rotary Converters	Universal Motors
Double Current Generators	Variable Transformers

Write for free descriptive literature.

Universal Scientific Company, Inc.
1102 Shelby Street **Vincennes, Indiana.**

DIE-LESS DUPLICATING

DI-ACRO Precision Machines—Shears, Brakes, Benders—have made possible "DIE-LESS DUPLICATING" for small parts and pieces. Leading schools and universities and many War industries use them. Ideal for training courses. Investigate.

In illustration, left to right: 1st: DI-ACRO Shear squares and sizes material. 2nd: Brake makes angles, channels, "Vees". 3rd: Bender forms angle, channel, rod, tubing, wire, etc.

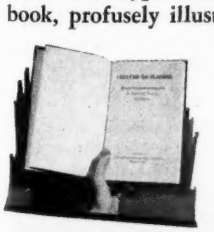
Send for catalog "METAL DUPLICATING WITHOUT DIES"

DI-ACRO PRECISION MACHINES

O'NEIL-IRWIN MFG. CO. 355 8th Ave. South Minneapolis, Minn.

Teach Metal Planing Easily

With a Treatise on Planers in the hands of all of your pupils they can learn from the experience of thousands of Cincinnati Hypro Planer users. This 134-page, cloth bound book, profusely illustrated, is yours for only $1.



THE CINCINNATI PLANER CO.
3120 FORRER ST., CINCINNATI, OHIO

Enclosed find $1 for my copy of "Treatise on Planers."

Name .....

Street .....

City ..... State.....

THEY *all* FIT
THEY'RE *all* INTERCHANGEABLE
—INSTANTLY...and renewable

New! 16-page illustrated book "How to Build Scale Models for Defense." Expert information for your Shop Project Work.

SUPER KEEN—IDEAL FOR MANUAL TRAINING

Help the Navy! 500,000 scale model planes needed fast. X-Acto builds them better, quicker, easier. WRITE US NOW! X-Acto Crescent Products Co., Inc., 440 Fourth Ave., New York, N. Y.

X-acto REFILL BLADE KNIVES

What Do You Think?

What course that you took in your college training seems most valuable to you now in retrospect as a shop teacher?

States WILBUR D. HOPKINS, instructor in woodworking and elementary aviation, Schuyler High School, Albany, N. Y.:

When one has been in harness for a number of years, it is difficult to think back and remember the courses taken during the training period. To put a finger on the course which contributed most toward the teaching job becomes increasingly difficult the further one is from school days. Many of the things which a teacher learns during this training become second nature through daily use and application on the job, and a great deal of information which was extraneous is forgotten.

In the application of theories and principles there is much overlapping and probably no experienced teacher would say, "To solve this problem and in this situation, let's use the twelfth lesson learned in the courses in Organization and Teaching Shop Work."

Experience is still one of the best teachers, and an instructor soon learns that although basic principles apply to nearly every situation, their application varies with the situation. There is no such thing as a set prescription or solution for each problem.

Thinking back and trying to remember the names of courses and their content, it would seem that probably the course in "Organization of Teaching Material" has been most helpful in organizing and teaching unit trade courses. However, I feel that this course would have been more helpful if it had been organized by omitting some of the less important work and adding material which has since been learned from bitter experience to be all important.

In my industrial arts work, I would choose without hesitation a course taken in "Organization and Teaching Industrial Arts." I shall never forget learning how to analyze projects for teaching content. This skill, which has been improved through use and application, has been most valuable in selecting the projects for my courses. One wonders sometimes if instructors are as careful to analyze their projects for teaching content before assigning them to pupils as they should be.

It would be well for all instructors to take inventory frequently; to think back over some of the principles which they learned while training; to take stock of themselves and their work; to consider whether or not they are putting in practice these principles or whether they are using methods which follow the lines of least resistance and which give the least trouble in presentation. Unfortunately, some teachers are content with keeping students *busy*. One sometimes wonders if teacher training ever came into the picture at any time.

We can all profit by a more careful consideration of those principles which we took time to learn and thus improve our teaching in direct proportion to the principles applied.

States ALBERT K. LOPER, instructor in mechanical drawing, Allegany High School, Cumberland, Maryland:

It has been several years since I have been a regular college student, but thinking over the question involved I believe the mechanical drawing course I had in college was the most helpful to me. I am teaching that subject at the present time. I attended a teachers college (Winona, Minnesota) and the drawing instructor had in mind that his students were going to be teachers. He informed us that if we *knew* our *subject matter*, and could have *discipline* and were *interested* in mechanical drawing we should not have much trouble teaching our subject.

States DAVID T. ARMSTRONG, machine-shop supervisor, Jersey City, N. J.:

There is no one course that stands out in my background of training as having special value to me as a shop teacher. I had a pure liberal arts curriculum with Greek and Latin, English and social studies, mathematics and science. However, the combination of all this theoretical book knowledge emphasized the idea of the superlative importance of being able to use the hands in a skillful way. As a boy I grew up in a machine shop and an automobile shop. I worked for a good many years as an automobile mechanic and a machinist. My out-of-college education included courses in carpentry, electricity, plumbing, welding, sheet-metal work, and farming.

Because I was employed as a teacher I had more leisure time than individuals employed in a trade. For the past several years I have been devoting my summer vacation to working at a trade I studied during the winter. In this way I have built up considerable manual skill. I believe this is the way to acquire a genuine education. The foundation I got in college enables me to acquire the rudiments of a new skill quicker than my friends and colleagues who do not have the advantage of such an education.

The most practical course I had that is of great value to me now was some work in toolmaking. This was part of a defense-training program. At the present time I am serving my country as a machine-shop supervisor under the direction of the War Manpower Commission in Jersey City, New Jersey.

States ROBERT M. EWING, industrial arts teacher, Eastchester High School, Tuckahoe, N. Y.:

The college course which now seems most valuable to me is forging. The practical work at a forge gave me a "feel" for metals, and I developed a great respect for things made of metal. The related information provided a technical knowledge of kinds of metals, alloys, carbon content, temper, and various hardnesses required for different uses.

The course gave me a basic understanding of metals which carried over into other courses, including foundry, machine shop, and sheet-metal. That foundation has been continually useful in teaching not only metalshop, but woodshop as well. Since nearly all woodwork is done with metal tools, a knowledge of metals is essential in the operation, care and repair of power machines, and in the sharpening of hand tools such as saws, plane bits, and chisels.

In teaching woodwork, I find that if I can give the student an understanding of metals, he will do more and better work with greater confidence in his own ability.

Looking back, I believe the course in forging was a fundamental preparation for all shop work, and I am sure it has been an indispensable part of my training.

States G. A. BECKER, machine-shop instructor, West Technical High School, Cleveland, Ohio:

There are really two courses that come to mind. The first, dealing with industrial tests and measurements in an attempt to establish facts to forecast occupational success, has helped immensely in the guidance of shop students particularly now, as the course also included such items as the recent establishment of the occupational directory, occupational questionnaire for classification and test techniques of armed forces. It is of double interest to me since I am teaching both regular day school and Vocational Education for War Workers classes.

The other course I mentioned as seeming most valuable dealt with a clear-cut presentation of how theory is *applied* in practice. There is a vast lack of proper coordination of shop theory and shop practice which demonstrations, job or lesson sheets cannot bring out.

IN THE Morning Mail

● Brief comments about SCHOOL SHOP and the field it serves are invited. Address the Editor, SCHOOL SHOP, Ann Arbor, Mich.

Gentlemen:

We, in industrial arts work in this city, look forward to the issues of SCHOOL SHOP with a great deal of anticipation and interest. We think you are doing a grand job and we hope it will continue.

My particular subject is woodwork and I am looking for films on that subject. Do you know where they may be obtained?

RAYMOND SMITH,
Rochester, Minn., Schools.

Here is a list of available films on woodworking.—*Ed.*

The Woodworker. Des Moines: Vocational Guidance Films. Price $50. *Or* New York: YMCA Motion Picture Bureau. Rent. (16 or 35 mm, sound.)

Essentials of Woodturning. Chicago: Bell & Howell Co. Rent or sell. (16 mm, sound or silent.)

And So We Make a Draw-Top Coffee Table. New York: Albert Constantine & Sons. Free; transp. charge. (16 mm, silent.)

Gentlemen:

I was interested to note in the February SCHOOL SHOP the work being done in teaching radio at Highland Park. We instituted a radio course this year and I have been curious to know how it compared with what other schools were doing.

We began by assembling the necessary equipment and supplies and by setting up our test panel. Related work was confined to a study of the fundamentals of electricity. Types of circuits, sources of current, testing with meters of all types, and formulas, were studied.

Our test board is made up on ¾" plywood 18" high and covering the full length of three six-foot benches placed end-to-end. Most of

the units on the board came from old radios acquired from a local dealer who took them in trade. We got two- and three-volt voltmeters, variable condensers, rheostats, inductance coils, and the like, all of which can be connected on the board into circuits for tests . . . Outlets for 110 volts, aerials, and ground leads are placed at intervals on the board.

As projects, the boys have done soldering of splices, built a variable-voltage transformer for test purposes, and made crystal sets. They know the International Morse Code and are making an oscillator at the present time . . .

The class meets six times a week, once each day for 40 minutes except on Monday when an extra period of 45 minutes is provided for laboratory testing.

We use a course designed by myself and patterned after the War Department bulletins. Our textbook reference is *Principles of Radio* by Henney. Supplementary text is *Essentials of Applied Electricity* by Jones and a project book from *Popular Science* has been useful. The *Mallory Radio Service Encyclopedia* is of considerable aid as a source of symbols, abbreviations, and circuit diagrams. The General Electric Company cooperated in sending free lesson sheets.

We expect to complete a two-tube receiver and an AC-DC four-tube receiver before June.

I have patterned a pre-induction course in what we call "Fundamental Shop Comprehension" which we will begin teaching in April and will run for six weeks, five 40 minute periods per week. This course will cover plan and blueprint reading for the first two weeks followed by layout and measurement, use of precision tools, testing small machined parts, drilling, riveting, and tool grinding.

The course is offered to boys who cannot attend the regular industrial arts classes because of schedule difficulties. The boys are senior high school juniors and the expectations are that the course will aid in adjustment when they work in war plants this summer . . .

CECIL A. WARNER,
Mooers, N. Y., Central School.

Gentlemen:

SCHOOL SHOP has not been under probation with me but serving sort of an apprenticeship. I have been so much pleased with the efforts put forth by you in the past year that I have decided your magazine is one which should be in each of my shops, where it could be used hard by the students. I have subsequently recently placed subscriptions with you for each of the shops. In addition, many of my teachers are subscribers.

LAWRENCE F. ASHLEY, Chief,
Div. of Voc. Ed., Yonkers, N. Y.

Demonstrations

(Continued from page 14)

It is sometimes difficult to get the starting time of the two magnets exactly the same. It can be done by hand good enough for all practical purposes, but if greater precision is desired the magnetic device illustrated in figure 11 should be found useful. There are two electromagnets operated by battery and key. They can be energized by depressing the key and will hold the pendulums in the starting position. When the key is opened they will both be released at the same time.

news

WHAT'S DOING IN THE FIELD OF INDUSTRIAL EDUCATION

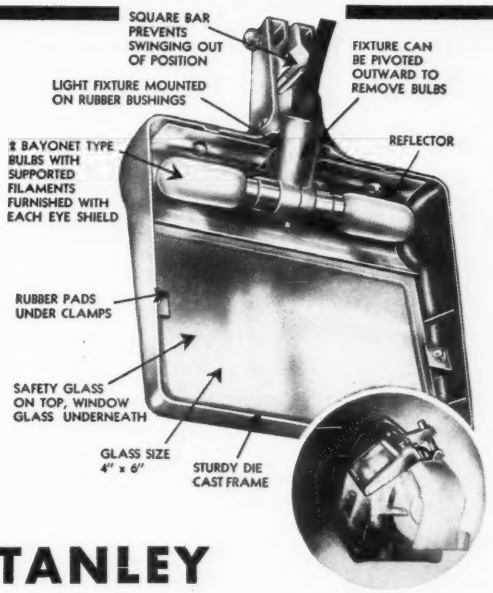
FIVE state associations have planned conventions this spring. Illinois Vocational Association will meet at Peoria, April 2 and 3. Indiana Industrial Arts Association will meet at Indianapolis on May 7 and 8. On April 10, the Connecticut Industrial Arts Association will meet at New Haven. On April 30 and May 1, the Wisconsin Association for Vocational and Adult Education will convene at Milwaukee. And on May 14 and 15, the Michigan Industrial Education Society will meet at Lansing.

ACCORDING to the U. S. Office of Education, scale models of military planes are in such demand that schools cannot fill the supply, even though they have delivered an estimated 400,000 planes to the Army and Navy.

Many officers in the armed forces have written the Office of Education, says J. C. Wright, Assistant U. S. Commissioner of Education, asking for sets of the plans so they can make their own airplane models.

A PARTICULARLY valuable June issue has been announced by the Publishers of SCHOOL SHOP. Outstanding feature of the issue will be a complete directory of all sources of supplies, materials, and equipment needed in shop work.

PROTECT STUDENTS' EYES FROM GRINDING HAZARDS!


SQUARE BAR PREVENTS SWINGING OUT OF POSITION
FIXTURE CAN BE PIVOTED OUTWARD TO REMOVE BULBS
LIGHT FIXTURE MOUNTED ON RUBBER BUSHINGS
REFLECTOR
2 BAYONET TYPE BULBS WITH SUPPORTED FILAMENTS FURNISHED WITH EACH EYE SHIELD
RUBBER PADS UNDER CLAMPS
SAFETY GLASS ON TOP, WINDOW GLASS UNDERNEATH
GLASS SIZE 4" x 6"
STURDY DIE CAST FRAME

STANLEY
"Flud-Lite" EYE SHIELD

Gives positive eye protection with excellent light directly on the work. Adjustable up and down for standing or sitting position. Cannot be moved to non-guarding position without dismantling. Can be easily applied on bench or belt-driven grinders. Write for details. Stanley Electric Tool Division, The Stanley Works, 112 Elm Street, New Britain, Connecticut.

1843 STANLEY 1943
TRADE MARK

STANLEY ELECTRIC TOOLS

instructional resources

Inquiries concerning materials described in these columns may be addressed to SCHOOL SHOP, Box 100, Ann Arbor, Mich., and will be passed on to the proper firm or person.

Amateur Radio: A Beginner's Guide. Fortune. Chicago: Thordarson Electric Manufacturing Co., 1940. Pp. 155. $0.75.

Covers from the amateur's viewpoint all of the essentials of radio operation: learning the code, receiver theory and construction, crystal-oscillator and two- and three-stage transmitters, modulator construction, and a chapter of reference material.

J. Douglas Fortune is a broadcast engineer, author of many articles on radio, and amateur operator W9UVC.

Bench Work Job Training Units. Chicago: American Technical Society, 1942. Pp. 155. $1.35.

Another in the Dunwoody Institute series of machine-shop job training units. A series of bench jobs, each with list of materials and tools, instructions, operating steps, precautions, questions, references, drawings, and job check sheets.

The series has been prepared and tested by members of the staff of Dunwoody Industrial Institute, Minneapolis.

Basic Bench-Metal Practice. Giachino, Feirer. Peoria: The Manual Arts Press, 1943. Pp. 160. $2.75.

A series of informational and instructional units designed to give the student necessary facts and to develop the skills he will need. Emphasis on industrial applications of bench metalwork. Illustrated; questions in each unit; tabular data; index.

J. W. Giachino, Lt. USNR, was formerly on the faculty of Western Michigan College of Education. John L. Feirer is professor of industrial arts at the same college.

Fundamentals of Applied Electricity. Jones. Milwaukee: Bruce Publishing Co., 1943. Pp. vii + 341.

In two parts: I, on fundamental principles of electricity and magnetism, simply explained; and II, directions for construction and use of experimental apparatus and equipment. Much related information is included in the text. Appendix; bibliography; index.

E. W. Jones is associate professor of physical science at Kansas State Teachers College, Pittsburg.

Technical Handbook. Lang. New York: Prentice-Hall, Inc., 1942. Pp. iv + 100. $0.80.

A book of data and brief instructions for solving problems in shop and factory. Subjects covered are arithmetic, problem solving, logarithms, preparing a report, drafting symbols, etc. Index; drawings.

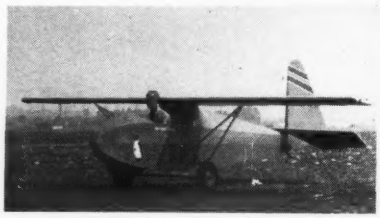
Edward H. Lang is supervisor of industrial education, New York State Department of Education.

Deltacraft Projects. Milwaukee: Delta Manufacturing Co., 1942.

A new series of project booklets involving the construction of small and large furniture, shelves, lamps, and other articles useful around the home. Emphasis is on design—simplicity and usefulness being stressed. Titles of the several booklets are: *Small Furniture Designs; Forty Fine Tables; Novelties; Furniture Designs; Toys, Games, and Playground Equipment; Garden Furniture and Novelties; One-Evening Projects; Nineteen Charming Chairs;* and *Twenty-one Lovely Lamps.*

Prices of these books vary from 10 cents to 25 cents. Informational leaflet available on request from Delta Manufacturing Co., Milwaukee, Wis.

NEW! PRE-FLIGHT GLIDER TRAINING for SCHOOLS



PENGUIN J-12 Pre-Flight Glider used in High Schools and Colleges.

DESIGNED for National Defense Pre-Flight Glider Training, the PENGUIN J-12 GLIDER is absolutely safe. The student learns perfect co-ordination and mastery of controls while he becomes familiar with actual flying.

The PENGUIN J-12 is easy to build in the average School shop, requiring non-strategic materials that are available in all communities.

START GLIDER TRAINING IN YOUR SCHOOL NOW!

Prepare your students for a future in Aviation. Help your Country produce the needed technically trained young men and women to do their share for VICTORY!

COMPLETE Pre-Flight Training and Construction Manuals with photographs, blueprints and instructions have been prepared for school use.

FOR FURTHER INFORMATION AND LITERATURE WRITE

CALIFORNIA AERO GLIDER CO.
Dept. SS-A
1829 W. 62nd St.
Los Angeles, Calif.

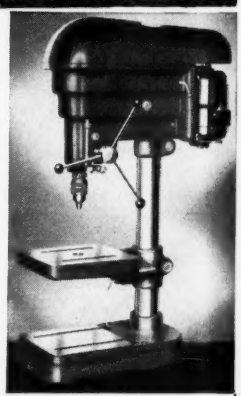
Chanute Penguin

BOICE-CRANE SAFETY-ENGINEERED PRECISION-BUILT SHOP-TESTED POWER TOOLS

MAKE ROOM FOR MORE TRAINEES • EFFECT QUICK SHOP EXPANSION • ASSURE SAFETY FOR INEXPERIENCED HANDS • AVAILABLE NOW

OVER 60 MODELS

BOICE-CRANE No. 2600 Helmet Head Drill Press



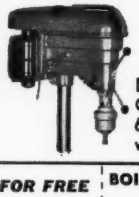
One, two, three and four spindle types. High and slow speed; bench or floor type; slotted or trough table.

Perfectly balanced and vibrationless.

Sealed against hazards common in other presses. The only drill press priced under $100.00 that gives you an approved guard without extra cost; the first guard that allows easy speed changing.

5 carefully predetermined efficient speeds, one for every operation. New self-centering 30-degree pressure angle 6-tooth involute spline. Spindle, quill, and spindle-pulley are held in permanent, perfect alignment.

The quill, longer and larger in diameter, is held by three bearings, permitting long holes to be drilled more accurately than by other presses in same price range. It is unquestionably the most durable and sensitive of any press in its class.



BOICE-CRANE TAPPING HEADS
for Helmet Head Drill Presses

Do light tapping better, cleaner, more economically. Operate at 3000 r.p.m. "IN"; faster than others, and 6000 r.p.m. "OUT". Taps enter every hole centrally without slightest strain. 2 sizes.

FOR FREE 48-PAGE CATALOG USE THIS COUPON

BOICE-CRANE COMPANY • 938 Central Ave., Toledo, Ohio

Name_____

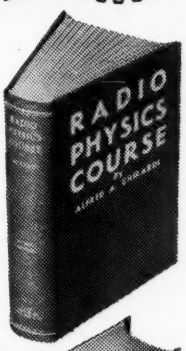
Street_____

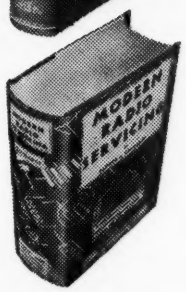
City_____

THICKNESS PLANERS • TAPPING MACHINES
SAW JOINTERS • DRILL PRESSES • BELT SANDERS
SPINDLE SANDERS • BAND SAWS • SPINDLE SHAPERS

FOR THE INSTRUCTOR who suddenly finds himself called upon to TEACH RADIO!

GEARED TO TODAY'S PRE-INDUCTION TRAINING PROGRAM





For years, Ghirardi Radio Books have been first choice of radio instructors in leading schools as well as for home-study throughout the country. Their practical, self-teaching texts make them especially suited for the U. S. Army Signal Corps, Mechanic-Learner, Radio and Junior Repairman Trainee Courses, and all other proposed courses in the Fundamentals of Radio for which they are recommended.

RADIO PHYSICS COURSE
by A. A. Ghirardi

This famous book has given more people their basic radio training than any other ever published. It is now used in more U.S. Signal Corps, Navy and civilian school and college courses than any other radio text book. Simplified, with every last detail explained thoroughly to effect instant, clear understanding, it not only covers everything from the fundamentals to the newest things in Radio—but has the added advantage of containing the all-essential foundation knowledge of Electricity (over 300 pages on this subject alone) that is necessary first before radio can be studied and understood. Everything possible has been done in it to make learning Radio easy—down to the 508 clear illustrations and the 856 self-testing review questions at the ends of chapters. Contains 972 big pages. "The book Radio students prefer to use."

Price Only $5.00

MODERN RADIO SERVICING
by A. A. Ghirardi

The only complete 1-vol. course in radio repair work, from the very fundamentals of test and servicing instruments to the actual troubleshooting and repair of the most complicated all-wave receivers by the most advanced methods. Includes 723 self-review questions and 706 clear illustrations. Thorough, clear, easily understood . . . either for class instruction or home study.

Price Only $5.00

HOME and VEHICULAR RADIO TROUBLEFINDERS for STUDENTS

These ingenious Trouble Locators will help your radio students learn about the causes and remedies of the many troubles common to home and vehicular radios. They are both fascinating and helpful. Almost anyone can use them intelligently to diagnose and correct radio troubles from the Symptoms, even without previous radio knowledge. They consist of sets of die-cut printed cards, eyeletted together at one corner. Pull down the card corresponding to the Trouble Symptoms in question and, instantly, all the probable Causes and their Remedies are revealed. One gadget covers home radios, one covers vehicular radios. Pocket size, 4¾"x7".

Only 50c each. (School discounts on quantities.)

FREE COURSE OUTLINE!

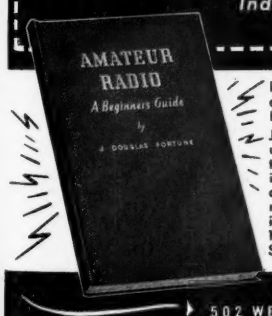
Instructors, send postcard to Dept. SS-43 for illustrated book folders and FREE Ghirardi Radio Physics Course Study Assignment & Page Reference Outline as Applied in the U.S. Signal Corps Mechanic Learner-Radio Course.

GHIRARDI RADIO BOOKS

RADIO & TECHNICAL PUBLISHING COMPANY, 45 Astor Place, New York City

YOU NEED THIS GREAT BOOK!

Indispensable for all Teachers and Students of Radio



Recognized and endorsed by radio experts, teachers, and all interested in radio, as one of the most practical, helpful, and authentic radio text books yet written.

J. Douglas Fortune's book is authoritative, readable, understandable! It covers everything from learning the code, on through receiver theory, the actual building of transmitters, modulator . . . etc. etc. right on to complete reference chapter explaining in detail most minute operations. A really indispensable book for pre-induction training! Beautifully bound in cloth—over 150 pages—post-paid for only 75c...or at bookstores. Special prices on quantity purchases by teachers.

THORDARSON ELECTRIC MFG. CO.
502 WEST HURON STREET • CHICAGO, ILL.

For your

Pre-Induction Course in
Fundamentals of Electricity

Slack's

ELEMENTARY ELECTRICITY
Revised Edition

A book for beginners, based on modern electron theory, with mathematics reduced to a minimum. Principles illustrated by many practical problems. New chapters on Magnetism and Electrostatics. 19 new illustrations. $2.00

Smith's

ELEMENTARY APPLIED ELECTRICITY
Third Edition

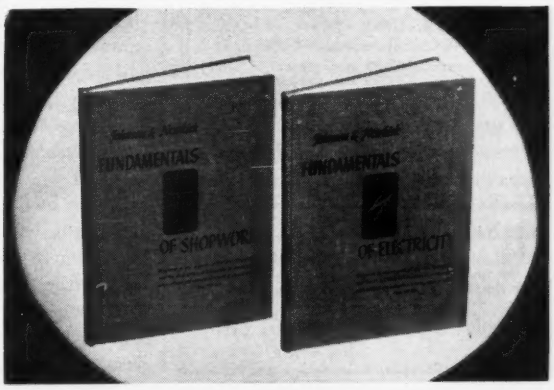
Presents fundamental principles of the electric current and everyday applications. Mathematical sections carefully planned to insure clearness. Three new chapters—Static Electricity, Electric Lighting, and Rectification of Current. $2.00

Send for copies on approval.

McGRAW-HILL BOOK COMPANY, INC.

330 West 42nd Street, New York

JOHNSON AND NEWKIRK PRE-INDUCTION TEXTS



The Fundamentals of SHOPWORK — **The Fundamentals of ELECTRICITY**

New and authoritative texts that follow with absolute conformity the Army specifications in skilled training as set forth in the TECHNICAL AND FIELD MANUALS OF THE WAR DEPARTMENT.

Prepared by experts with years of experience in organizing and teaching the fundamentals of science and shopwork.

Scientifically illustrated with pictures of tools, equipment, and step-by-step procedures.

Each $1.32 (list price, subject to usual school discount)

THE MACMILLAN COMPANY New York, Boston, Chicago, Dallas, Atlanta, San Francisco

Everyone Can Use this Handy OHMITE Ohm's Law Calculator

Solves any Ohm's Law Problem with one setting of the slide...

EXTREMELY helpful in the training program today. Helps your students figure ohms, watts, volts, amperes—quickly, easily. No slide rule knowledge necessary. All values are direct reading. Two sides cover the range commonly used in electrical and radio work. Size 4⅛" x 9". Yours for only..... 10c

TEACHERS

Write for information on how you can obtain a quantity of these calculators for your students at a special price.

OHMITE MFG. CO. 4835 Flournoy St., Chicago

Be Right with OHMITE
RHEOSTATS · RESISTORS · TAP SWITCHES

PRE-FLIGHT 16 MM
TRAINING FILMS
SILENT
AIRPLANE WELDING (2R)
AIRPLANE RIVETING (2R)
Making of an Airplane
FITTING (2R)
AIRPLANE SHEET METAL WORK (2R)
Rental: $3.00 per subject
Sale: $48.00 per subject
Send for Complete Information
WALTER O. GUTLOHN, Inc.
25 W. 45th St. Dept. L-4 New York

Teacher-Trainers

SCHOOL SHOP provides excellent classroom material for your teacher-training program. Write today for our special rate for group orders for prospective teachers. Address . . .

Circulation Department, SCHOOL SHOP
Box 100 ANN ARBOR, MICHIGAN

Projects for AIR AGE EDUCATION
To assist in teaching the principles of aeronautics, we have developed a number of practical classroom aids. They range from a simple paper glider to a wind tunnel. Write for our Air Age circular illustrating our Wind Tunnel, Air-O-Trainer, Graded Projects and numerous kits.
Comet Model Airplane & Supply Co.
129 W. 29th St., Chicago 559 Sixth Ave., New York
Dept. S-3

Seeking a Position?

For nearly twenty years we have been filling educational positions throughout the East and South, specializing in Industrial Arts and Vocational subjects. There are many opportunities for advancement this year. Write, telling us about yourself.

The Baltimore Teachers Agency
Member National Association of Teachers' Agencies
WILLIAM K. YOCUM, MANAGER
516 N. Charles St. Baltimore, Md.

Training Teachers *THROUGH EMPLOYMENT*

BY *Earl L. Bedell*

Head, Department of Industrial Education, Wayne University and Director of Vocational Education, Detroit, Mich.

MOST teachers will consider it a patriotic duty to contribute to the war effort in a substantial way during the summer periods. Also, we know that teachers are eager to advance themselves professionally whenever possible.

The summer cooperative plan at Wayne University, Detroit's Municipal University, makes it possible for a teacher to accomplish both of these objectives and at the same time earn enough money to pay his summer expenses. This is accomplished by obtaining employment for these teachers in local industry.

A recent conference arranged between employment managers and members of the Industrial Education staff in Wayne University of Detroit indicates that there is a great need for the services of skilled shop, drafting, and technical subject teachers in essential war industries this coming summer. A working relationship has been set up and plans prepared to carry on a cooperative teacher education program between Wayne University and Detroit's industries. The industries will provide jobs to students and teachers of industrial education and Wayne University will offer closely coordinated courses for the summer session which will tie in with the work experience provided by the industries.

During the past summers this plan has proven to be very popular as most teachers are eager to supplement and bring up to date their industrial experiences in order that the instruction which they offer in their schools may be made worthwhile for their students. This plan is arranged to include both industrial arts teachers and teachers of related subjects as well as teachers of basic trade subjects. In order to set up such a program the University is scheduling classes at a time so that they will not conflict with the student's working schedule in industry.

Get the "Know How" on the Job.—An appreciation of the problems of labor and industry may only be obtained by actual participation on the job in industry. Shop teachers are expected to be in a position to counsel their students in order to prepare them to bridge the gap between the school training atmosphere and actual work on the job.

Modern foundry methods eliminate much tedious work but the skill of the foundryman is still important. Drafting and shop teachers benefit from foundry experience as it gives them contact with foundry problems as brought out in variations of design and construction. (Photo courtesy Ford Motor Co.)

There is but one way for a teacher to gain these experiences: through actual work on the job in industry.

Some special courses are being established which closely coordinate work in industry with the usual shop and drafting room situation to the end that the student will gain more from his experiences in both industry and the college classes.

Advantages to Industry.—The demand by industry for men with both educational and industrial training is almost as great as that of the schools. Industrial education fits the teacher for many payroll jobs both in engineering and in personnel positions. This is amply borne out by the number of shop and drafting teachers who have found their way into important positions in the manufacturing plants in the Detroit area. They have contributed much in helping industry solve their training problems.

Industry also recognizes that they have much to gain from a cooperative plan involving the employment of teachers while they attend the University. First, they will gain through the better trained students which they will receive from the school; second, the student will reflect a better understanding of labor management problems; and third, the students will be a more select group as a direct result of better teacher guidance.

Front Cover . . .

The young man on the cover is an apprentice machinist working at a shaper in the shop of the Samuel Gompers Trades School, San Francisco, California.

Forged Coat Hook

BY *Harold L. Forsea*

This project is used in lieu of the traditional gate hook and the author has found that students are much more interested in it because of its utility around the home. Mr. Forsea writes that he does not spend much time on forging in his general shop course so that several small projects are stressed, rather than one large one. He states that this procedure satisfies the needs of an exploratory course. The author teaches Industrial Arts at Corning, California, Union High School.

TESTED INSTRUCTIONAL PROJECT

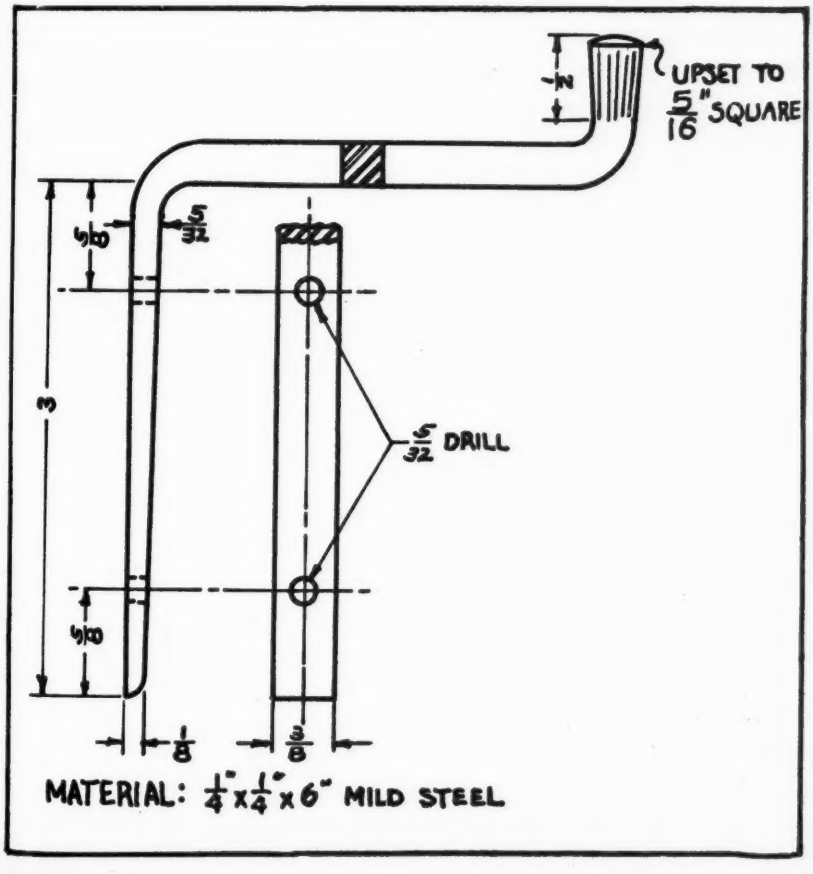
THIS is an introductory forging project in our general shop. When completed, the student has learned something of several fundamental forging processes, accomplished in a few class periods and with very little material. Supplied also with two ¾" No. 7 roundhead wood screws, he can find many practical uses for it, such as hanging Dad's hunting coat and cap in a back closet "for the duration."

After exhausting our supply of ¼" square iron and scraps, it was found that "used" ¼" square reinforcing steel works out well on this project.

General Instructions: Mild steel is forged at yellow heat. Too much blast will cause heavy scaling which is undesirable. Use a hot coke fire, but do not force the heating.

Suggested Procedure:

1. Build up a small coke fire.
2. Cut stock to length using cold chisel or hardy.
3. Pick out tongs that hold stock safely.
4. Upset one end to about 5/16" square.
5. Flatten 3" of the other end until it is ⅜" wide. *Do not let the piece lengthen.*
6. Make a small bend at the upset end; forge this to your own choice.
7. Make the second bend.
8. Straighten the hook.
9. File sharpness off edges of upset end.
10. "Blue" the filed spots by heating.
11. Centerpunch and drill the two 5/32" holes.
12. Clean off the scale with a brush.
13. Clean up with lacquer thinner or other solvent.
14. Give one end coat of clear lacquer.



Strictly Personal...

ABOUT YOUR FELLOW TEACHERS

PAUL F. RAFTERY is the new director of Milford, Mass., Trade School, replacing DAVID I. DAVOREN. Also new at Milford Trade School is EVERETT M. WINSLOW, who comes from St. Johnsbury, Vt. . . . O. B. BADGER, formerly with the Tulsa, Okla., schools, is now assistant superintendent of Portland, Ore., schools. . . . Dr. WAYNE P. HUGHES, assistant professor of industrial arts education, Eastern Illinois State Teachers College, Charleston, has been granted a leave of absence to take a special assignment with the Education Division of the National Safety Council. His task will be to determine what industrialists regard as safety shortcomings of industrial training centers, and to help various states build programs to overcome these deficiencies. . . . P. G. FRAISER, research director for the Iowa State Board of Vocational Education, has been made principal of the new vocational high school, Des Moines, Ia. The school is to be devoted to training of war workers, and will operate on a 12-month schedule. . . . New principal of Edison Occupational School, Cleveland, Ohio, is MICHAEL J. ECK, formerly supervisor of printing in the same school system. . . . THOMAS H. QUIGLEY, formerly professor of industrial education, Georgia School of Technology, has been appointed Director of the U. S. Employment Service in Georgia.

Noise . . . *(Continued from page 6)*

As to the physical treatment of machinery, it can only be said that each of the ten items suggests its own attack. Grease, oil, a wrench, a bolt here and there, some kerosene and emery cloth, will accomplish wonders. Try running each machine individually in an attempt to find where it may be noisy. Check and, if necessary, tighten or scrape belting. Use some sandpaper on the motor commutators. Dress the emery wheel and have the door check readjusted. Acoustic treatment of old buildings is rather difficult. Some have, however, been rejuvenated through the use of such substances as Celotex on walls and ceilings. It is before construction of new buildings that the architect calls in an acoustic engineer for consultation and makes his plans along modern, sound-absorbing lines. We can do a great deal, nevertheless, to ease the noise menace in our older buildings and shops through close attention to discovery of cause and to study of treatment.

from WASHINGTON by WILLIAM PACA

"GRATIFIED" is the word both Army and Civil Aeronautics Authority officials use to describe their reaction to the progress of two programs about which Washington has had its fingers crossed for some time—Pre-induction and Pre-flight Training.

● On the first counting of noses of students enrolled in pre-induction training, the War Department found 1,300,000 boys taking the "fundamentals" of radio, machines, shopwork, electricity, and auto mechanics. The figure is based on reports from the 48 states and includes students in both private and public high schools. The boys taking this work —all prospective inductees—are 16 years or over. But in addition to this first constituency—as Army and training officials like to call the 1,300,000 boys—out-of-school youth, adults, and illiterates, still uncounted, make up another great constituency.

Thus, the supply of candidates for these courses certainly taxes the facilities for training them. For one thing, Washington has not yet figured out any way to supply materials and equipment for pre-induction work. When your reporter asks Army officials what schools are doing for materials and equipment, the answer is: "They improvise." Commercial equipment and "kits" meet some of the needs of some of the schools.

● Pre-induction officials were disappointed when the House Appropriations Committee failed to approve a request for $2,390,000 which would have been used to improve in-service teachers in science, aeronautics, and mathematics. Pre-induction training and vocational education generally would have profited by the teacher-advancement the funds would have made possible, although the request grew out of the needs of the High School Victory Corps. However, the House of Representatives said "No."

It was February when the House said "No" to the request; in March a Senate Subcommittee said "Yes." The difference of opinion is now being ironed out.

● Problems of equipment and teaching personnel also plague the pre-flight training program, although on the whole CAA officials are satisfied with its progress. To date, about half the Nation's high schools have pre-flight courses, enrolling 250,000 youth.

Need for materials in this program was met in part by private publishers of textbooks—one series of "air-age" books selling more than 500,000 copies so far. During the early stages of this program, the physics laboratory was the principal center of instruction. Now, however, the school shop with its wind tunnels and model airplanes is gaining favor with teachers and pupils engaged in pre-flight education work.

How well this program has been going will become evident during May and June, when the Civil Aeronautics Authority will give the Private Pilot Ground School Examination to an expected 100,000 students.

Teacher supply for pre-flight work was eased somewhat by teacher-training work set up in 250 colleges under the leadership—and with funds—provided by the CAA. About 3300 teachers thus prepared themselves for pre-flight work without paying tuition. Similar opportunities will be available on an even broader scale this summer.

● A magazine devoted to the interest of the Nation's schools, has published an article which is causing considerable comment in Washington. According to the author of that article, "Federal Control Creeps On." He says that if the U. S. Office of Education sets up full-time regional representatives America will have a "full-blown system of educational satrapies and the American tradition of state and local educational administration will sustain another body blow." The author admits that such regional set-ups may be an emergency measure, but he says, it is a "safe wager that regional offices will be a permanent feature."

Will school-shop teachers really be working soon under satrapies? To take soundings of the tide and temper of these dreaded developments, your reporter plunged right into the problem.

He found that in order to *decentralize* the functions of the Bureau of Training (War Manpower Commission) the Bureau will now operate through a Chief of Training in each of the 12 War Manpower Commission regions. Incidentally, these regions had originally been set up in 1935 by the Social Security Board as a means for decentralizing activities.

Your reporter also found that the Chief of Training in each region will be advised by regional representatives of the programs grouped under the Bureau of Training: Apprentice Training, Training Within Industry, Training for War Production, etc.

Your reporter found no evidence in these developments that this pattern will breed a provincial organization of some federal education agency. For one thing, the regional representatives continue to deal with and through the state departments of education.

Your reporter has found, however, that the U. S. Office of Education, as an independent unit, prefers to continue its customary practice of working through the states rather than regional organizations. For example it has set up its High School Victory Corps field activities on state lines.

Furthermore, your reporter found that federal education officials are too busy doing a job asked for by Congress, by the War Production Board, and by the Armed Forces, to think about recasting our lines of educational organization; and that many government officials themselves—some fresh from the states— are as allergic to federal control of education as is the author of the above-quoted article himself.

Index to Advertisers

Allied Radio Corp. 13
American Technical Society 15
Baltimore Teachers Agency 22
Boice-Crane Co. 20
California Aero Glider Co. 20
Casein Co. of America 9
Cincinnati Planer Co. 17
Comet Model Airplane & Supply Co. 22
Eagle Pencil Co. Cover 4
Franklin Glue Co. 9
Walter O. Guthohn, Inc. 22
Higgins Ink Co., Inc. 14
Lafayette Radio Corp. 15
Logan Engineering Co. Cover 2
The Macmillan Co. 21
McGraw-Hill Book Co., Inc. 21
McKnight & McKnight 17
Meissner Mfg. Co. 13
Ohmite Mfg. Co. 22
O'Neil-Irwin Mfg. Co. 17
Racine Tool & Machine Co. 17
Radio & Technical Publishing Co. 21
John F. Rider Publisher, Inc. 15
Sheldon Machine Co. 9
Skilsaw, Inc. 2
South Bend Lathe Works Cover 3
Stanley Electric Tool Div. 19
Stanley Tools 13
L. S. Starrett Co. 9
Thordarson Electric Mfg. Co. 21
Universal Scientific Co. 17
Wayne University 15
X-acto Crescent Products Co. 17

Speed WAR PRODUCTION TRAINING

USE THESE BOOKS AND FILMS ON LATHE OPERATION

Today's big problem is the training of machinists for the thousands of new jobs in war industries and to replace the men who have gone into the armed forces. Production goals have been increased, yet standards of precision and quality must be maintained even with these new workers. To accomplish this, a vast army of men and women must acquire new skills in the shortest possible time.

To help you train new lathe operators, we offer the practical aids listed below. These books and films on lathe operation and care have proved effective in hundreds of apprentice training schools, including Army and Navy training stations.

Write for Information on These Practical Training Helps

MOTION PICTURES—"The Lathe" and "Plain Turning"—two new 16 mm sound films in color on the basic principles of engine lathe operation. Available on a free loan basis. Showing time 20 minutes each. Write for circular.

HOW TO GET THE MOST OUT OF YOUR LATHE—Specialized service bulletins on the care and operation of engine lathes. H-1, "Keep Your Lathe Clean"; H-2, "Oiling the Lathe"; H-3, "Installing and Leveling the Lathe"; H-4, "Keep Your Lathe in Trim." Sample copies mailed on request.

HOW TO RUN A LATHE—A practical 128 page handbook on the operation and care of metal working lathes. Contains 360 illustrations. Written in a non-technical style easy for the beginner to understand. Used as a shop text book by the Army, Navy, Air Corps, and countless schools. Price 25c. Sample copy free to shop instructors.

THREAD CUTTING—A 21 page book on how to set up a lathe for cutting various screw threads; setting cutter bits; thread formulae; metric threads, etc. Price 10c. Sample copy free to shop instructors.

GRINDING CUTTER BITS—12 page book on grinding lathe tool cutter bits. Covers identification and application of various bits, methods of grinding, correct angles, etc. Price 10c. Sample copy free to shop instructors.

ARMY E NAVY

SOUTH BEND LATHE WORKS

LATHE BUILDERS FOR 36 YEARS — SOUTH BEND, INDIANA

TRADE MARK SOUTH BEND ENGINE LATHES